THE

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THE WELSBACH GAS BURNER.

THE promoters of the Auer-Welsbach burner are displaying a wonderful amount of activity in introducing the new incandescent gas light, and many people seem to be willing at least to give it a trial. We, for reasons given further on, do not believe that it is a light which has come to stay, and, perhaps, after a fair trial of its merits, we might have allowed it to die a natural death, or to be snuffed out or wrecked by a bluebottle, but no rival to the electric light can be despised or neglected, so we must estimate both its strength and its weakness.

Here it is claimed that when new and under good conditions, this burner will give 52 candle-power with 3·75 cubic feet of gas per hour, and in America 55 candle-power for 4·6 cubic feet. Herein lies one of its greatest advantages, cheapness. It is the cheapest source of light, taking only the gas consumption into account, but to this must be added the cost and maintenance of the mantles and chimneys. From advertising circulars we may take the life of mantles at about 500 hours, when good and carefully managed, but it seems that many of them have a much shorter life. Thus, in Vol. cxvi., *Transactions* Civil Engineers, London, it is said that "In four months 14 mantles and 25 (chimneys) cylinders were required for renewals with four lanterns." The breakage of a chimney usually destroys the mantle; the mantle is exceedingly feeble and easily broken; so much so, that one user complains in *Electricity*, of New York, that "the bother of keeping in order, especially in the summer months, when flies and other insects got into the tubes and 'queered' the mantles, made it unpopular;" so, with the cost of renewals, the saving in gas may very likely be more than counterbalanced in time. Still, as people do not so much desire the same light for less money as more light for the same money, the increase in light due to the mantle is its great recommendation.

The colour of the light is, for advertising purposes, advantageous; it at once attracts attention, and the contrast to be seen in one street we recently passed through is very striking. Common gas and electric incandescent lamps are used in shops on each side of a window lit by Welsbachs, while the street itself is furnished with arc lights; the gas and electric incandescents seem yellow in the glare of the arc, while the Welsbachs, with their greenish white light shine out, catching the eye at once.

But this very characteristic is their most objectionable feature for ordinary interior illumination. The colour is simply intolerable; dresses, decorations, pictures, colours, and so on, assume most unearthly tinges when illuminated by this "greenery yellery" light; the general effect is ghastly, and reading by it painful.

It is used in shops largely because it attracts as an advertisement, and because of its new appearance; but novelty

soon wears off, and once familiarised, its advertising value will disappear.

While it has all the objectionable features of common gas burners, with the additional one of bad colour of light thrown in, all that can be claimed for it is that it gives about three times the luminosity with the same amount of gas; but in the face of the renewals required, we do not see how any valid claim for efficiency and economy can be made.

Its colour alone is enough to exclude it from house lighting and places of amusement, but the most serious drawback, when compared with electric light, is that while the electric light entirely frees a house from the products of gas combustion, the incandescent gas burner fills a house with these products.

Among the products are to be found poisonous gases, whether in a large or small percentage does not matter much, for a small quantity from each light soon accumulates to a large percentage in interiors; it is only a question of time, number of burners, and capacity of interior when the effects will be felt.

Carbon monoxide has been found in the products of combustion from Welsbach burners. It is a very dangerous gas and is poisonous in small quantities.

It may not be always formed in the combustion, but at some time or other it is formed, probably from a deficiency of air. At any rate, we know that carbon monoxide is often given off by Bunsen flames.

For these reasons, we do not believe the incandescent gas lamp can be seriously considered as a successful rival to the electric light; it is conspicuous at present, and therefore attracts people fond of display, but it has nothing to recommend it to ordinary individuals who want a good light, perfectly cleanly, safe, and with an agreeable colour like the electric incandescent lamp.

There is also the question whether the actual illuminating power is as great as that stated. The measurement of illuminating power with different coloured lights is not at all an easy matter, and it would be difficult to match this Welsbach light in colour for measurement purposes. The light is spectroscopically found to consist largely of green and yellow rays.

We know the eye to be much more sensitive to green and yellow than to any other rays of the spectrum, so that the direct rays falling upon the eye give an impression of great brilliancy when the light comes from a source rich in green and yellow. But objects are seen by the rays emerging from them, not from the source of light, and every object absorbs and sends out different rays according to its nature. Hence, if any rays are deficient or superabundant in the light, so that it is not pure white, we do not get illumination corresponding to the apparent brilliancy.

The incandescent mantle brings out green and yellow colours to a disagreeable extent, while the light from the incandescent lamp brings out the warmer orange and reds; colours to which the human eye at night has for centuries been accustomed. Arc lights, when good and coming from pure carbons, bring out the various colours very much as daylight does, as the light has almost the same composition.

Electricians in the States are watching the new light very carefully, and many have related their experiences in the American electrical journals. We should be glad to learn what impression the Welsbach lamp has produced in the minds of electrical men at home.

Explosions.

THE question of explosions in electric light conduits has become intensified by the recent accident in Euston Road. Most of our readers will have seen the accounts in the daily press, so we need not go into details here. The accident of course took place in the system of electric light mains owned by the St. Pancras Vestry. The conduit and man-hole which were affected by the explosion contained copper strip conductors. It seems reasonable to suppose that there was an accumulation of coal gas or other explosive mixture in the box, which was fired and caused an explosion or a series of explosions. Mr. J. T. Baron, the engineer to the Vestry, was on the scene ten minutes after the occurrence, and he states that there was then a distinct smell of coal gas. There seems to be, however, some difficulty in determining how the gas was fired. It is certain that at 11.56 p.m. a "short" was recorded at the station, but whether this had anything to do with the explosion we cannot say; the police constable who was near the accident states that it happened about two minutes to twelve, but we should think that under the circumstances an error of time might be easily made. There was nothing to indicate in the condition of the mains or their surroundings that a spark or an arc had taken place, but then it is quite likely that a general upheaval might eradicate any such signs. An elaborate system of examination of mains was rigidly carried out by the electric lighting department of the Vestry, and the man-hole in which the explosion occurred was examined on Friday and presented no abnormal appearance. Such occurrences are real misfortunes to electric lighting, but they might easily have been worse. We are, however, face to face with the fact that explosions are liable to occur in conduits, whether they contain high or low pressure mains. To restore the confidence of the public it is imperative that some drastic alterations be carried out. Precisely on what lines these improvements are to proceed, must be left to electrical engineers as a body. It is a matter which in its seriousness calls for some concerted action, and we trust that members of the industry will meet together and consider with equable minds how we are to avoid such lamentable accidents as those which have occurred in Cannon Street and Euston Road. The Board of Trade have offered time after time suggestions for the avoidance of accumulations of gas, and if these are reasonable—we have no reason to think they are otherwise—they should be adopted without hesitation. There is no question that such accidents can and must be avoided. It is a strong argument against conduits that buried mains, if properly made and laid, never cause explosions, and it would seem that circumstances are forcing us back to this method. These explosions in conduits may be taken as indications of considerable want of foresight on the part of engineers who have been responsible for their construction. That coal gas existed in the soil was well known long before electric light mains found it out, and it is to guard against such things that the services of the consulting engineer are required, yet it is quite evident that in these cases of explosion no provision whatever has been made to meet the leakage of gas into the conduits. The spark or arc or red-hot conductor which fires the gas is also direct evidence of bad design or faulty construction. The responsibility for such weak points in a system must ultimately come back upon the engineer. Water leaking in may also be the cause of explosions; it may liberate gas, and can also start a spark.

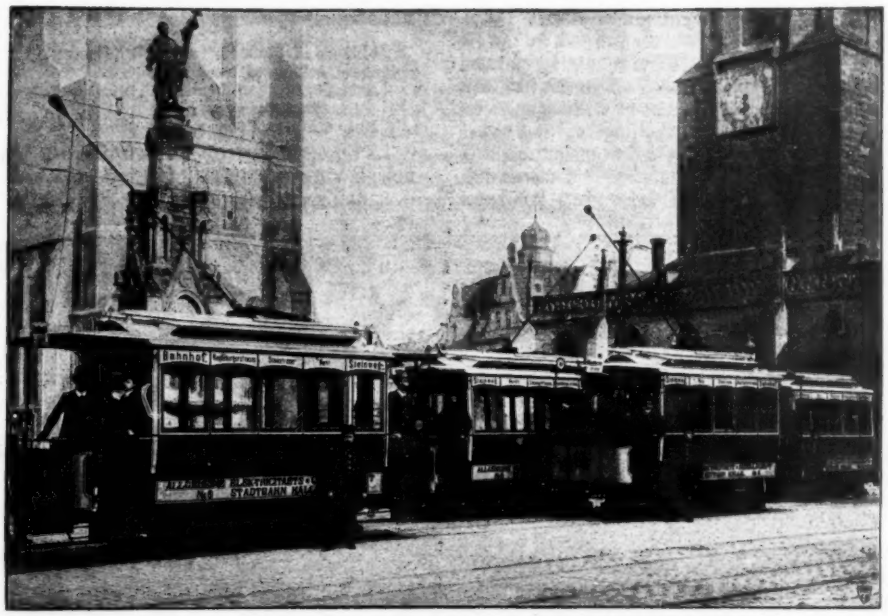
ELECTRIC TRACTION IN EUROPE.

By PHILIP DAWSON.

Widespread interest has been exhibited throughout Europe in electric traction during the past year, and it would seem more than probable that within the next twelvemonth great practical progress would be made toward its general adoption.

The learned societies and the engineering and scientific press have devoted no small amount of time and space to the discussion of the subject in detail. The stock objections have not been advanced so forcibly as heretofore, and no semblance of opposition is made to the general proposition than an extension of tramway and light railway service is an essential requirement of modern life, and that the best system of mechanical motive power available must be employed in the place of the inefficient, inconvenient, and antiquated methods which have survived their time and outlived their usefulness.

It is unnecessary to repeat the story of American progress in this regard. The work that has been done, and is about to be undertaken on the Continent, is quite sufficient to show the signs of the times. We have repeatedly been told that the trolley car and the trolley wire, so greatly in vogue in America, were hopelessly unsuited to European conditions, and could never find anything like the same general acceptance that has been extended to them on the other side of the Atlantic. The statistics that are to-day available go far to disprove that assertion, and it may now be confidently predicted that by the end of 1895, Europe will be well on the way toward as general an introduction and as wide a use of electrical motive power for both metropolitan and suburban passenger traffic as now maintains in America.



A Stopping Place of the Electric Cars at Halle.

The Electric Tramway Passing Through the Handsome Tauentzien Square at Breslau.

Nearly 1,100 electric motor cars are now in regular operation on the Continent alone, employing about 20,000 H.P. in station engines, and approximately 400 miles of track have been electrically equipped. Moreover, contracts are already signed for nearly 500 more motor cars, 12,000 additional engine H.P., and 350 miles of track construction.

With the single exception of Buda-Pesth, where a conduit system is in operation under the especially favourable conditions which prevail in that city, every electric road equipped of late years, has adopted the American method of construction in every essential particular, and no suggestion of a possible departure therefrom has been made in the contracts for additional cars, station plant and mileage.

But one tangible objection has ever been urged to the extended use of electrical motive power, viz., that an elevated conductor must necessarily be suspended above the roadway, no other means for the supply of current at a reasonable cost having yet been evolved. Much of the force of that objection has disappeared with the great improvement made in methods and appliances for aerial insulation and suspension. Prof. Silvanus Thompson, in his remarks upon the paper recently read by Mr. Wilkinson before the Institution of Electrical Engineers, sums up the matter by saying that his personal observation of American electric tramways leads him to conclude that of all overhead wires, the trolley wire is the least obnoxious, and has the best reason for its existence.

As against this one objection, we can call attention to many manifest advantages, of which the comparatively reasonable cost of installation and operation rank first. Comfort, speed, cleanliness, the convenience of the working classes and the extension of the suburban residential district (an indispensable hygienic requisite of all modern cities), also follow close upon the introduction of electrical traction.

At Bremen, the electric lines are worked 28 per cent. cheaper than the horse tramways. At Marseilles, the working expenses of the electric cars which have now been running some three years, are 4d. per car mile, while the horse lines of the same city are worked at 6·12d. per car mile. On the South Staffordshire tramway, the working expenses by electricity are slightly over 4d. per car mile. The steam tramways in the same district, with cheap coal available, average 7·31d. per car mile. The Roundhay electric line at Leeds, operated under many difficulties, is worked at less than 5½d. per car mile.

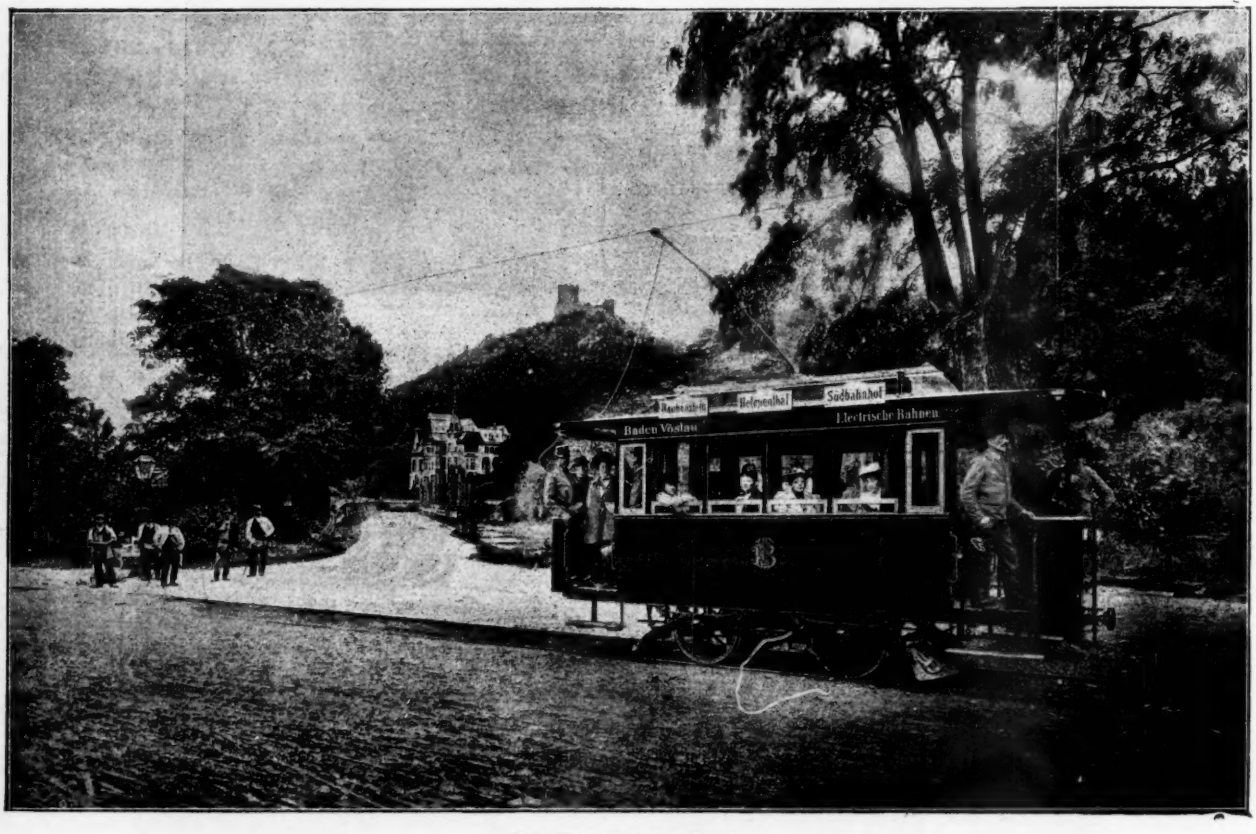
Careful study of all the figures available, demonstrates that the working expenses of European trolley lines averages very considerably less than 5½d., and that the average ratio of operating expenses to receipts is well under 60 per cent. The average cost of operation of English horse tramways, according to Duncan's Tramway Manual, is 9½d., and the ratio of their working expenses to receipts, 81 per cent.

These figures are sustained by the results obtained in America. The official report of the Railroad Commissioners of the State of Massachusetts gives us the following statistics:—

	1888.	1893.
Mileage of track electrically equipped ...	0	711
Total mileage of track	534	874
Average ratio of working expenses to receipts, in per cent.	81·07	69·26
Net earnings per car mile, in pence ...	2·78	4·82

In European electric traction progress, Germany is an easy first, having already 180 miles of track electrically equipped, over 630 cars, and more than 8,000 station engine horse-power in operation. In the same country, further contracts have been already let for 230 additional track miles, over 280 more motor cars, and a further amount of 5,500 H.P. in engines. Hamburg, Bremen, Lubeck, Dantsic, Leipsic, Dresden, Munich, Nuremberg—all have electric tramways in operation or under construction, and it must be noted that these are cities replete with artistic, historical, and antiquarian interest. It is scarcely uncalled for to say that a method of rapid transit which is there considered thoroughly acceptable, is probably quite as suitable to English needs, and unlikely to prove the æsthetic outrage which we have heard of in this country.

A very noticeable feature in connection with the introduction of electric cars, has been the freedom from accident to the public. On the Halle line in Germany, there has been only one accident to life or limb for every 88,638 car miles run. The Berlin horse tramway statistics show one accident to every 41,625 car miles. It may also be said that the speed of the electric cars is much higher than that of the horse cars. These figures are amply supported by American results. In Boston, the statistics show a single accident to



The Baden-Voslau Line.

every 52,475 electric car miles run. In the State of Massachusetts in 1893, one passenger out of every 686,662 carried was injured, and one fatality occurred for every 106,776,004 passengers carried by the electric lines. The larger part of these accidents were caused by passengers jumping from the cars before they were brought to a stop.

It may reasonably be hoped that the Board of Trade may see its way to remove, in part, the restrictions upon speed. On the Continent far greater latitude is allowed, high speeds being forbidden in city streets, but increased speed up to 12 or 15 miles an hour being allowed on country tramways or lines running through thinly settled suburban districts. The perfect control under which an electric car can always be held, and the extremely short distance within which it can be brought to a stop, are assurances of safety to the public. The average daily car mileage of most continental lines reaches 100 miles, and in America sometimes 200 miles per car. The ordinary horse cars rarely average over 50 to 60 miles in a day's work.

Another unnecessary restriction, and one which will probably be removed in time, is that which compels the use of a current not exceeding 300 volts. Aside from the benefit which accrues therefrom to the manufacturer of copper wire, no possible advantage is gained from this limitation. A current of 500 volts potential is quite as safe as one of 300 volts from every point of view. On the Continent the pressure nearly universally used on trolley lines is from 500 to 600 volts.

Our illustrations show: (1) A stopping place of the electric cars at Halle. (2) The electric tramway passing through the handsome Tauentzien Square of Breslau. The lines in these cities have been installed by the Allgemeine Elektricitäts Gesellschaft, of Berlin, and are operated with marked success, both as regards the public service and financial results. (3) The Baden-Voslau line constructed by Schückert & Co., of Nuremberg (Elektricitäts Aktiengesellschaft), connecting two popular Austrian watering places.

THE PRESENT POSITION AND PROSPECTS OF ELECTRIC TRACTION IN THIS COUNTRY.

BY M. HOLROYD SMITH.

So much has been published in the technical press from time to time on the question of electric traction, that there hardly seems any excuse for writing more. What good can be accomplished by adding to a subject that has been dealt with by numerous and various writers, some who have devoted much time, thought, energy, and enterprise to the subject, some who, having read a little, thought a little, made many calculations on assumed data, and not being troubled with such commonplace matter as solid facts and experience, have allowed their untrammelled pens to write line upon line. To be candid, there is very little left to say that is new and interesting to the initiated, but to the world beyond there is still very much. The first principles of electric traction are very imperfectly understood or realised by the lay mind, and perhaps only partially grasped by many who would not like to be so classed, or else why do the same things keep appearing again and again, the notions that have been thought out, experimented with, and abandoned, are brought forward as newborn wonders to revolutionise science and practice.

The object of this article is for general more than technical considerations, and even then little can be advanced that has not been said, and better said before, the only room for diversity being the relative importance given to various causes.

Over a million and a quarter is invested in the United Kingdom on enterprises, dependent for their success on electric traction, a fact hardly realised by those who grumble at the lack of progress. By that statement let it not be supposed that £1,250,000 is expended in electric plant only; for example, in the City and South London Railway and the Liverpool Overhead, the electric plant is comparatively a small portion, but a most important part, for upon it the success of the whole depends. Will anyone venture to say that traction on either of the lines quoted could have been as well done by any other known means?

Although it is from a national point of view satisfactory to have actual proof of the skill and ability of English electrical engineers, proof that they have not to go elsewhere to learn how to execute any work entrusted to them, still, it is to be regretted that the national purse has not been more fully opened to enable more public benefit to be derived from the skill and resources available. What is the reason of this restraint? The question has been asked over and over again, and perhaps the best way to proceed is for the electrical world to ask themselves how far they are to blame for the delay. Electrical engineers are not immaculate, their human nature is pretty much the same as that of other men, and it cannot be matter of surprise that they should watch carefully their individual interest, but it must, to a reflective mind, be a matter of regret, that there has not been more concerted action amonget them. A little less time and money spent in the law courts, and more clubbing together for mutual advantage, might be more to the benefit of all concerned. The enterprise would not so often be stopped with the speech, "When doctors disagree," &c. Just an example: the owners of a tramway think it might be worth their while to change from horses, and ask for terms from some one experienced, not only in the technique, but in the business side of the subject, which results in a statement showing that whereas it now costs the Tramway Company 10½d. per car mile with horses, it will only cost 8½d. if worked electrically. This figure leaks out, and in rushes some brother electrician with a competitive scheme, declaring it can be done for 3d. No 1 is put on oneside, because the Tramway Company are given the impression that he is asking too much, and wants to make too much profit. No. 2, who is given the option of proceeding, finds that to obtain the necessary capital he must pay much more to the financers than he had any idea of. Nobody will lend him the money for 5 per cent. interest, he finds drivers and conductors, inspectors and checkers, engine men and car cleaners, all want higher wages and less hours than he expected, that some hard fisted landowner won't let him have the land whereon to build except at a ruinous price, the town authorities want to rate him at the highest rate on every conceivable point, his directors expect some remuneration for their valuable services, the tram company actually want him to compensate them for the value of their horses and harness, which will be useless to them if they allow him to work electrically, and they will not promise him the line for more than ten years, and he must, therefore, have such a rate per mile that will enable him to create a sinking fund that will pay off the capital in that time. It is slowly but surely borne home upon him that 3d. per car mile won't pay for all this, and he begs to be excused, and secretly wonders how No. 1 dared to offer to undertake the work at 8½d. In the meantime the shareholders have lost the benefit of the 2d. which would have given them what they have never received before, viz., a dividend, for the tramway directors think they had better wait and see what further improvements will be made, as "electricity is only in its infancy." Oh, that a millstone were round the neck of the man who set that phrase going, and kept so many would-be users always waiting for improvements. Admit if you like that electricity is only in its infancy, but claim that the infant must have fresh air and exercise, or else it cannot grow, and don't suppose because you see some other person's infant occasionally stumble and hurt itself, yours would come forth as a strong man and rejoice to run a race.

Has not a lot of difficulty arisen from failing to realise the stress and the strain the little infant had to face and overcome? It will be found that success has only attended those who have risen above the decimal point and provided weft and sinew enough.

Perhaps the greatest internal cause (*i.e.*, arising from the electrical world) has been the constant flaunting before the eyes of the public the mystic battery. That box from Paris taken to Glasgow, containing a storage of energy enough to move mountains, still lives in the imagination of the public, and a plausible enthusiast can still persuade a body of otherwise clearheaded business men, that they must not have their horse lines converted into electric lines by any direct method overhead, underground, closed or open conduits, &c., because a battery—a new battery—is just coming out

that will make all such expensive and dangerous (?) devices unnecessary. Oh, electricians, why grumble at the hesitation and delay of the public, when you have yourselves to blame? The battery that can compete with direct driving does not yet exist, then why delay and hinder work because you hope for one? The only commendable use for batteries, advocated as long ago as 1888, has at last been put into practice on the Douglas and Laxey line. Surely in a technical paper it is not necessary to argue on the subject, but it is unfortunately necessary to beseech men not to allow their zeal to go beyond all claim to discretion. Who would venture to say that a battery or some equivalent will *not* be discovered? Who would put a limit upon what patience and research may some day evolve from the wonderful forces of nature, but such things as yet are not, and, therefore, who (able to examine and reason and not carried away by an enthusiasm that cannot be commended) can consistently delay true progress and present possibilities by dreams of what may be. Some day a submarine boat will start from Liverpool and dive across to New York regardless of wind and wave, no storm hindering its swift progress, but those who have important business in America had better not wait till the *Nautilus* is built.

Now for the outside causes—circumstances over which electrical engineers *per se* have no control.

Most English towns where the traffic justifies the outlay already have tramways.

The roads in England are usually so good that ordinary vehicles can safely and easily be run upon them, whereas in America it may be said that, as a rule, the roads are so abominably bad that the only safe means of vehicular traffic is the tramway. The influence of this is much greater than the British public can fully realise.

England, an old country, is conservative to the backbone. Even those who profess a liberal creed in politics are conservative in all things else. How is it that our enterprising men must go elsewhere if they wish to earn for themselves a reward for their labours? Cable lines first suggested here were not tolerated until their innings had been played out in America, and then, forsooth, when they are rapidly being supplanted by electric lines in the States; then, and not till then, did borough engineers think fit to advise their corporations that they are fit and proper things to be adopted in English towns.

It is worthy of note that the Portrush, Bessbrook, and Blackpool lines, which may be taken as typical examples of electric traction were all working successes before any electric street railways were commenced in the States, and yet it was not until the rapid advance and deserved popularity of electric traction there, that English authorities and English financiers could be brought to seriously regard its introduction here. Truly we are a conservative nation.

As an ordinary and civilised people, we do not want that liberty which extends to license. We still wish to protect our property and person from the ruthless vandalism committed often by the "Bird of Freedom" when he soars, but there are customs more honoured in the breach than in the observance, and there is some comfort in the assurance by the Board of Trade of a willingness to help instead of hinder the utilisation of the results of science for the public benefit.

Another serious cause of delay, and one difficult to face, and very tender ground to trespass upon, is the financial condition of the existing tramway companies. Very few of them can afford to make any serious addition to their plant. This is neither the time nor place to enter into a criticism of why they cannot—sufficient to lament the fact.

The recent decision of the House of Lords is regarded by many as a disturbing and retarding factor, but surely if that decision be carefully examined by disinterested minds it must be regarded as a just one. Its result to those interested is certainly distressing, but the only comfort that can be offered them is the poorest comfort of all, viz., they have only themselves to blame. There is an old proverb which speaks about laying by for a rainy day, and many of those old time proverbs contain truth which cannot be disregarded with safety.

Is it necessary to give any more reason for the delay? Unfortunately most of them still exist and must be faced.

Take the last first: The decision of the House of Lords, though a dark cloud, has a silver, nay, rather a golden lining, for it will most probably result in the corporations and town councils acquiring the tramways, and when they come under the control of the representative of the ratepayers, the residents in one ward will object to be taxed for a tramway in another district unless they can have one also. This will result in extensions. It will also be possible to construct the tramlines at less initial cost, because the corporate bodies can obtain the necessary money at 3½ per cent., whereas few companies can get it for less than 15 per cent.; many are subject to 50 per cent. when all costs are counted. Admitting that a corporate committee is not always composed of men easy to deal with, neither is the directorate of a company. The committee may drive a hard bargain but they will pay in cash, and that to a manufacturer is usually more acceptable than paper. The Lords' decision may therefore be fairly expected to result in more work and certain pay, though the profit may be small.

Respecting regulations and restraints, as already stated, the Board of Trade now wish to facilitate progress as much as possible. This is manifest by their decision anent the telephone and tramway companies, and by the conference held to consider the very important question of Light Railways, which opens out a wide field for electric traction in its various phases. There will of course be cases where electricity will not be the best power to use; some case where batteries may be better than direct driving if electricity is used at all; but it may be taken for granted that when the passenger traffic justifies the construction of a line, and when the advantage of a frequent service is fully realised (say a car holding 20 every half hour instead of a train carrying 80 every two hours), then in the majority of cases, electricity by direct driving, in some form or other, will prove to be the best motive power.

For the cure of some of the other causes mentioned we must look to time, experience, and patience, and a little more of that good fellowship which is usually associated with the incoming of a new year.

Prospects are certainly brighter than they have hitherto been. The way is open now, the skill is ready and waiting, but the means are still wanting, and those means are best obtained by concerted action on the part of all interested.

HIGH PRESSURE v. LOW PRESSURE.

By RANKIN KENNEDY.

The time has gone by when we could profitably consider the distribution, at high pressures, of electrical energy among consumers.

The high pressure system which has survived, is one limited to the supply of sub-stations from the power house, the distribution being carried out from these sub-stations at low pressure. Thus a compound system has come into vogue.

This dual system, if we may use the term, is an old one, having been proposed and patented by Siemens and Halske in 1885.

In special cases, such a system has decided advantages. In these cases the power houses will be placed, for the sake of obtaining certain advantages, far from the consumers. But it is very doubtful if such a compound system has any advantages in many of the places where it has been installed. In this article I propose to touch lightly upon the *pros* and *cons* of the high and low pressure question. In the early days, high pressure was thought to be sufficient for distribution, and the victory of the alternating current advocates was gained under that belief. But now that the low pressure network has been found indispensable in municipal supplies, there arises a very nice question for engineers as to how much is to be gained, in any given case, by the use of high pressure feeders, and under what circumstances are the advantages of high pressure great enough to warrant its adoption?

These questions have not been discussed hitherto; it is not a question now of alternating versus continuous current; both may be worked at high or low pressure; it is simply a question of high *versus* low pressure in the feeders; this narrows the inquiry very considerably. If the circumstances

are such that high pressure feeders show a considerable saving in first cost, and in maintenance and in future extension, then alternating current must be used.

If low pressure feeders do not cost more than 10 per cent. over and above the high pressure feeders, including transformers, chambers, switches (automatic or otherwise), conduits, and laying down outlays, &c., then continuous current must be used, for although we might supply low pressure alternating current equally well, yet the continuous current has so many advantages that it is preferable.

In fact, it must always be borne in mind that electrical energy, in the form of continuous current, is much more generally useful than alternating current. This fact is not at present realised, for the simple reason that both currents are equally good for the only purpose to which electrical energy is most largely applied at present, that is, lighting incandescent lamps.

For arc lamps the latter is also used, but not satisfactorily from the user's point of view. The humming sound is objectionable in interiors, and such are the advantages of continuous over alternating arcs in street lighting, that rectifying the alternating current for that purpose has become quite popular.

If rectifiers are used, they also must be charged against the high pressure feeders, together with all their attendant expenses and maintenance.

But if electrical energy ever becomes so cheap that it can be used for other purposes besides lighting electric lamps, then there would arise a larger demand for continuous current.

It is only a question of copper. It is always contended that the low pressure system requires the laying down of a copper mine in the streets; but if the high pressure system requires the low pressure network, just the same as the low pressure system, then I, for one, cannot see how we are to escape this copper mine difficulty. We can at best only escape from laying down a few additional tons of copper in the feeders, while incurring the cost of transformers, high insulation, and rectifiers.

No doubt, at first, when a supply is laid down, the difference in cost between a high and low pressure system is much greater than it will be later on as the full load comes up, because at first the low pressure mains are few and short, and not heavily loaded; hence engineers find that they can make a start with much less capital outlay on the high pressure system, and therefore it is adopted without a view to the future, and the cost of building up of the low pressure network is not found in the first cost.

In this way high pressure plants are often unfairly and unfavourably compared to the low pressure plants; in fact, at the outset, most high pressure systems are nearly all high pressure distribution systems; it is later on, when the cost of the added low pressure mains can be taken into account, that the true comparison can be made.

Then there is the question of loss of pressure in the two systems of feeders. In the one kind we have losses by induction and by magnetising currents; in the other we have only $C^2 R$ losses. The $C^2 R$ loss is not a great all-day loss.

The advent of improved storage, whereby the whole supply might be met by stored energy, and the steam or gas plant worked 24 hours a day continually storing, and never working direct from the machinery, would knock the bottom out of the whole alternating current plan. This is the solution of the all-day load, and the method of surmounting the Alpine peaks on the load curve. Under such a system, the steam or other generating plants presently in use would supply just about seven times the present annual output.

The great future before the alternating current lies in transmitting large quantities of energy over long distances: from coalfields, waterfalls, or other distant sources of energy. For this purpose, three-phase generators, motors, and converters must be used, or, as at Niagara, two-phase currents may be adopted. Little or nothing in multiphase work has been done in Great Britain, yet there is some scope for that work, but it is hopeless to look for anything being done with it in ordinary municipal engineering. A large engineering scheme for the transmission of energy can only be handled by a company guided by competent engineers.

Compressed air is a rival in this field of transmission, and wonderful progress has been made with it in Paris; and, as electricians, we must not underestimate the strength of the enemy. Compressed air is the only powerful rival in the whole field; it may, therefore, be of interest to see what it can do. According to the calculations of Prof. Unwin, air compressed by 10,000 horse-power to 132·3 lbs. per square inch can be transmitted 20 miles in a 30-inch main, with a loss of pressure of only 12 per cent., and an air motor at the 20 miles distance would give a brake or effective horse-power of 6,041, a total efficiency of over 60 per cent. Under more favourable conditions it is possible to obtain a total efficiency of over 70 per cent.

High frequency experiments still present some enigmas for investigation; no satisfactory explanation has been given of the harmlessness of high pressure at high frequency. That there is no horse-power behind it may explain its harmlessness; but if there is no power behind it, what raises a lamp filament to incandescence when held in the hand, and connection made only through the body? The two effects are contradictory. A current through the body sufficient for incandescence of the lamp would be fatal. There is something here to unravel.

Luminescence has been further studied, but little progress made towards producing light without heat, except on a very small scale. The author does not think high frequency necessary to produce luminescence, for in experiments made many years ago it was found that luminescence could be produced by high pressure alone, but high frequency intensifies the effects. Nearly all bodies are luminescent. The simplest way to experiment with various bodies is to send a spark discharge through them in a dark box with an eyehole. Such simple objects as apples, oranges, pears, billiard balls, &c., give each its peculiar light on the passage of the discharge, which from a condenser is of high frequency. Luminescence is probably an effect of harmonics, like harmonics in sound waves. Besides the fundamental frequency of the spark, harmonic vibrations of a much higher frequency are set up in the bodies exhibiting luminescence; hence the effects of resonance, which Ebert notices, may also be explained.

In the minds of those who have experimented on luminescent lighting, there cannot be the slightest doubt of the ultimate success of this principle as a means of illumination; and that, too, before long. The data for the solution of the problem is rapidly accumulating, and many able men are on that research.

The author feels convinced that we already have the key to the solution, and that what is most required at present to advance the subject is the collecting together, and the general interpretation of the meaning of the results obtained.

Luminescence may be produced in bodies in the air, or in a vacuum, and may be excited either by direct discharge through them, or by a negative discharge directed upon them. It is therefore quite within the bounds of possibility that we shall yet have lamps of this kind requiring no vacuum.

THE LIGHT OF THE FUTURE.

By JOHN GRAY, B.Sc.

The Electrical Review has recently issued a valuable list of the electric light central stations of Great Britain, giving the cost of the electric light and the price of gas for each locality. If we take 6d. per Board of Trade unit as the most usual price for electricity, the price of gas to furnish the same amount of light at the same cost may be easily found. A 12 C.P. incandescent lamp uses, say, 30 watts, and a 12 C.P. gas jet consumes, say, 5 cubic feet of gas per hour. In 200 hours the electricity consumed by a 12 C.P. lamp is $30 \times 200 = 6{,}000$ watt hours $= 6$ units; in 200 hours, a gas jet, 12 C.P., consumes 1,000 cubic feet of gas. The 6 units of electricity at 6d. per unit amounts to 3s., to which add $\frac{2}{3}$ths of a lamp at 1s. 3d., amounting to 6d., and we find that electricity at 6d. per unit is equivalent to gas at 3s. 6d. per 1,000 feet. If the Electrical Review list of some 95 central stations be examined, it will be found that in only five recorded cases is the electric light cheaper than gas.

Notwithstanding the fact that the cost of producing electric light is, on the average, greater than the cost of produc-

tion of gaslight, there need be no apprehension that the electric light will not make steady progress. The difference of price is not great, perhaps on the average in this country electric light costs 1½ times as much as gaslight; and when the destructive action of the products of combustion are allowed for, the gross cost of electric lighting may be somewhat less than that of gas lighting. In any case, it must be admitted that the race between gas and electric lighting is very close, and any improvement in the efficiency of either will enable it to go easily ahead.

Gas lighting has recently received a considerable impulse from the introduction of the incandescent gas light invented by Carl Auer von Welsbach. A great increase in the amount of light emitted per cubic foot of gas consumed has undoubtedly been attained. It is said that 3 to 4 cubic feet of gas per hour give a light of 50 candles, *i.e.*, four or five times as much as the ordinary gas jet. Some experimental tests by Heim * do not give quite so good a result; a light of 48 C.P. was obtained in the horizontal direction, but at an angle of 45° this had fallen to one-half; the average consumption per candle-power was 0·1 cubic feet per hour. This light also contains an excess of green rays,† which appears to increase as the mantel gets older. The great objection, however, to the Auer or Welsbach light is, as one of its critics has put it, that "it burns the same old gas," and though in somewhat less quantity, we get the same objectionable carbonic acid gas, sulphurous acid gas, &c., and the same great development of heat which are associated with the old gas jet. Where cheapness is not the first consideration, there can be little doubt the electric light will, in the long run, displace the Welsbach. Whatever objections may be urged against the Welsbach light, it is useless to deny that it considerably reduces the cost of lighting by gas, or at least gives more light for the same consumption. It becomes, therefore, all the more urgent to inquire what prospect there is of a more economical production of the, in every way preferable, electric light.

During the past year, two promising inventions have seen the light of day in the electrical world, and unless they contain, concealed in their constitution, the germs of premature decay, their development will lead in the future, not only to the universal application of electricity for lighting, but also, perhaps, for the production of power. One, the invention of the "luminescent" lamp, by Prof. Ebert‡, promises to produce 2,000 candle-power where only one is produced at present by the gas or oil flame; the other, the invention of a gas battery, by Dr. Borcher,§ produces electric energy direct from fuel, and three times more than we now obtain by the intervention of the dynamo and the steam engine.

In Ebert's luminescent lamp, light is produced by the luminescence or phosphorescence of a substance of the nature of luminous paint under the influence of cathode rays in a vacuum bulb. Ebert and Wiedemann had shown in previous investigations that regular, weakly-damped, electrical oscillations possessed a very remarkable power of exciting electrical oscillations of great intensity, and, further, that these cathode rays have the capacity of producing luminescence in suitable bodies, with an extremely small expenditure of energy. Taking advantage of these discoveries, Ebert has designed his lamp, and a simple apparatus for producing the necessary regular, rapid, and persistent electric oscillations. The wave apparatus somewhat resembles that used by Tesla in his experiments in the same field. Oscillations are produced in a primary circuit by the passage of a spark over a short air gap, and the rate of oscillation is controlled by small air condensers and transformer coils, through which latter oscillations are produced in a secondary circuit containing the lamp and tuned to be resonant with the primary circuit. The resonance of the circuits appears to be essential to the maximum economy.

The most remarkable circumstance about Ebert's lamp is its extraordinary efficiency as a producer of light. He states that a lamp giving a serviceable bright light, with a consumption of only one-millionth of a watt, may be made. It is not quite clear from Ebert's description what the candle-power of this lamp was, but he goes on to say that "if the brightness of this lamp, in the visible part, is compared with that of the amyl acetate unit lamp, and the total energy expended in maintaining each lamp be calculated, it will be found that the luminescent lamp requires about 1,500 to 2,000 times less energy than the unit lamp."

As these statements of Ebert's have been received with a considerable amount of incredulity, it is desirable to examine whether or not they are necessarily inconsistent with what we already know. Unfortunately the experimental data available for determining the efficiency of different sources of light are somewhat incomplete, and by no means in close agreement. Langley, by means of the bolometer, plotted out the radiant energy in the spectrum of an argand gas flame, and found that 2·4 per cent. of the total area lay in the visible part of the spectrum. He assumed that 25 per cent. only of the total energy produced by combustion took the form of radiant energy, the rest being dissipated by convection or otherwise. Julius Thomsen,* however, found in his experiments that only 15 per cent. of the total energy of combustion appeared as radiant energy. Taking Thomsen's figure as the more reliable, 15 per cent. of 2·4 per cent. gives 0·36 per cent., or $\frac{1}{278}$th as the ratio of energy producing light to the total energy of combustion in the argand gas flame. According to Thomsen's experiments the efficiencies of the gas and oil flames were about the same.

Assuming, in the absence of direct experimental data, that the efficiency of the amyl acetate flame is about the same as that of the oil and gas flame, we can see that it is at least theoretically possible for a lamp converting all the energy supplied to it into luminous radiation, to produce 280 times more light than the amyl acetate flame for the same total expenditure of energy. Now, Ebert found that his luminescent lamp gave from 1,500 to 2,000 times more light than the amyl acetate unit, *i.e.*, five to seven times more than would be theoretically possible, provided always the same rate of expenditure of energy in the luminous part of the radiation produced the same candle-power. I am afraid the mechanical theory of light is not sufficiently developed to enable us to give any decision on this question. There are, however, some interesting experiments by Merritt† on the light efficiency of the incandescent electric lamp, which show that the ratio of the expenditure of energy of luminous radiation to the candle-power is by no means constant. The experiments were made with an Edison 16 C.P. lamp. When, with a small current, the candle-power of the lamp was 0·9, the ratio of the luminous watts to the candle-power was 0·59, at 16·3 C.P. the ratio was 0·28, and at 38·2 C.P. the ratio was 0·19. Here we see that the efficiency of a given number of watts in the luminous part of the spectrum, to produce intensity of light, varies in a ratio of 3 to 1. There is nothing, therefore, inconsistent with these results in supposing that a given expenditure of luminous energy in the luminescent lamp produces 5 to 7 times greater intensity of light as measured by candle-power, than the same amount of energy produces in the amyl acetate flame.

The extraordinary efficiency of Ebert's lamp is, therefore, theoretically quite possible. In an argand gas flame burning 5 cubic feet per hour and giving a light of 15 C.P., ⅓ of a cubic foot of gas is consumed per candle-power per hour. The complete combustion of 1 cubic foot of gas produces 525,000 foot lbs. of energy. Therefore, to maintain a light of 1 candle-power, $\frac{525{,}000}{3} = 175{,}000$ foot lbs. of energy must be produced per hour. Of this, only 0·36 per cent. is luminous energy, and therefore the luminous energy per second in watts is $\frac{175{,}000 \times \cdot0036}{60 \times 60 \times \cdot738} = \cdot24$. Now, according to Merritt's experiments, this ratio with the incandescent electric lamp, when it is giving its normal light of 16 C.P., is ·28, so we may take it that the argand gas flame, the amyl acetate flame, and the incandescent electric light, are all very much the same as to the C.P. produced per watt of luminous energy. The ratio of the luminous energy to the total energy in the electric lamp, when giving 16 C.P. is, according to Merritt, ·054; in the amyl acetate unit we have taken this ratio as ·0036. The proportion of luminous energy in the electric lamp is therefore 15 times greater than in the

* *Electrotech. Zeit.*, xiv., p. 199, 1893.
† ELECTRICAL REVIEW, Vol. 35, p. 550.
‡ ELECTRICAL REVIEW, Vol. 35, p. 452. "Wied. Ann.," Vol. liii., p. 144.
§ ELECTRICAL REVIEW, Vol. 35, p. 616.

* *Pogg. Ann.*, Vol. 125, p. 248.
† *Amer. Jour. Science*, Vol. xxxvii., p. 167, 1889.

electric lamp, and we could only expect about 100 C.P. in the luminescent lamp for 1 C.P. in the incandescent lamp. Till a fuller account of Ebert's investigations is published we cannot be certain as to the exact increase of efficiency to be obtained; but even though it is not more than one hundred fold, it is enough to make the luminescent lamp the light of the future.

DETERMINATION v. EXPERIMENT.

PROF. AYRTON and one of his students, Mr. Haycraft, submitted a paper recently to the Physical Society on a "Student's Simple Apparatus for Determining the Mechanical Equivalent of Heat," which, when used with a good commercial ammeter, voltmeter, thermometer, and watch, would give the mechanical equivalent of heat correct to 1 per cent., without any corrections having to be made, and without any special manipulative skill being required on the part of the observer. During the course of the experiment no fewer than five measurements or observations had to be made, viz., current strength, potential difference, mass of water heated (with water equivalent of containing vessel, resistance coil, and stirrer), rise of temperature, and time during which the current is passed. In the criticism which followed, Mr. Griffiths, while admiring the design of the apparatus, questioned its value for educational purposes, since it eliminated all difficulties, and failed to familiarise the student with the intelligent application of corrections.

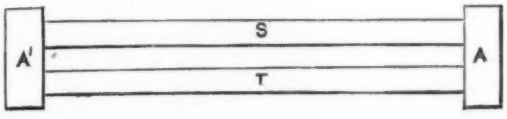
Prof. Carey Foster thought that the apparatus was a good example of the way in which experiments should be devised, but objected to the use, by students, of direct reading instruments, on the ground that such instruments gave no scientific information. Criticism like this is quite beside the mark. To our mind, the points which are here objected to are the very ones which make it of greatest educational value for experimental work. The object of the apparatus is to give young students a clear, *concrete* idea, of the mechanical equivalent of heat, a quantity which they have to deal with at almost every stage of their career, both in and out of college. To give them this in the simplest possible way, and free from all elements of perplexity, is the design of the experiment—this is its design and no other. It is not to be, at the same time, a lesson in calibration, or in the principle of the tangent galvanometer, or in the intelligent appreciation and application of corrections, all of which, while very excellent in themselves and in their own place, would simply confuse young minds and obscure the main issue. To those who are acquainted with the mental calibre of average junior students, these remarks will doubtless commend themselves. Prof. Rücker's remarks on the subject are very sensible. He said that if a student, in his future work, would merely have to use certain instruments, it would be sufficient that he should use them as he found them, in his laboratory work; but that if, on the other hand, he would in the future have to manufacture such instruments, he should be taught how to make them. The fact is, the curriculum of our large technical colleges is, like that of our public schools, divided into the three main sections of elementary, commercial, and classical. In his elementary course at school, the pupil has to learn those rudiments which are common to both of the others, and not till he decides whether he shall adopt a commercial (or scientific) or a purely professional career, does he definitely cast in his lot with the modern or with the classical side. It would surely be absurd to expect a youth who is destined for a commercial career to devote his energies to classical studies which, whilst admirable in themselves and as purely mental exercise, would waste his valuable time and prove of no practical benefit in his after life. When a young student enters on his laboratory course, he knows very little more than the bare rudiments of the subjects. Set such a one down to perform an experiment, with apparatus so rude that the result he gets after patient toil is very far from that which he knows theoretically to be the right one; or expect him, after he has plodded through the various stages, to calculate and apply a host of corrections—due chiefly to imperfections in his apparatus—about which he knows little and cares less, and he will be quite disheartened. It is certainly not advisable to smooth away all difficulties from the path of youth, otherwise there would be little or no incentive to continuous and determined effort; but let these difficulties be only such as young minds are capable of intelligently grappling with, and overcoming. We consider that if junior students set up the different pieces of apparatus, make all the necessary connections correctly, perform the experiment, make the measurements, and take the observations referred to above, and then work out their results correctly, they have done very well, and may leave the application of infinitesimal corrections to those who have decided on an academic career, and have, therefore, adopted the classical curriculum of the laboratory. But, after all, the students have done no more than perform an experiment; true, it is one which will give them a firmer grasp of what is meant by the mechanical equivalent of heat than any mere reading about it. Still, it is only an "experiment," and in no sense is it a determination. Determinations are for the physicist, and experiments are for the mere student. And this seems to be where the shoe pinched at the Physical Society's meeting. The authors of the paper described it as an apparatus for "determining" the mechanical equivalent of heat. A better, because a more accurately descriptive expression, would have been "experimentally verifying." Moreover they gave, in one section of the paper, the results obtained since 1879 by such physicists as Rowland, Dieterici, Miculesen and Griffiths, and stated that the results obtained by the students is greater than the mean of the results obtained by these four experimenters by just one-half per cent. Doubtless all that was meant by this was to show how reliable good commercial direct-reading instruments are even for such delicate work, and how successfully all sources of error had been eliminated in the design and construction of the calorimeter, but it seemed as if the work of callow students was being set up in comparison with that of past masters in the art, and this was a heinous offence. Let Prof. Ayrton take heed, and for the future be content to call a spade a spade.

A METHOD OF DETERMINING INDUCTION AND HYSTERESIS CURVES.*

BY FRANK HOLDEN.

IF a magnetic circuit of uniform cross-section be composed of parts of different permeability, and magnetomotive forces be applied uniformly along the length of each section having values inversely as the permeabilities of the sections to which they are applied, there will then be no external field from this arrangement and the magnetomotive forces will be easily calculable if all the dimensions be known, as shown in Gray's "Absolute Measurements in Electricity and Magnetism," Vol. II., page 281.

Perhaps the simplest arrangement of this is that shown in the accompanying cut, in which A and A′ are two blocks of soft iron drilled so that the two rods, which are uniformly wound from block to block, may fit well into them. Means for varying and measuring independently the current in each



coil is provided, and the coils are so connected that if the coil for the bar, S, magnetises from A to A′, then the coil for T magnetises from A′ to A. A sensitive magnetometer is placed so as to best show any external field between A and A′.

Knowing the induction curve of S, then by this arrangement may that of T be found. For by a variation of the currents the condition may be brought about such that there is no leakage between A and A′, and then the inductions in

* The New York *Electrica World*.

the two bars are necessarily equal, and the magnetising force for each bar during this condition is calculable from the distance between the blocks, L, and the number of turns, N, and the currents in the coils, C, $\mathfrak{H}$ being $\frac{4\pi N C}{10 L}$.

By reference to the induction curve of S, the induction value is found for S, and consequently for T. The magnetomotive force being calculated, one point in the curve for T is determined, and the others may be similarly found. During the adjustments of the currents, they must be frequently and simultaneously reversed to prevent any indefiniteness because of hysteresis.

By a somewhat similar procedure, the hysteresis curve of T for a certain maximum induction may be found if that of S for the same induction be known. The current for S is made to equal that needed to produce the maximum induction, determined by reference to the known curve and while both are being reversed, the current for T is varied until there is no leakage. The value of this current and reference to the known curve determine the highest point of the desired curve. The current for S is then decreased to a certain value and that of T decreased until again there is no leakage. The magnetomotive force for each bar is then calculable, and the induction found by reference as before to the known curve. This is continued until the currents arrive at the same numerical value but reversed, when one side of the curve will be determined.

Although it complicates calculation a little, yet it is possible to use bars of different cross-sections, and so give the apparatus greater range. The bars may be used of such a length that the reluctances at the joints do not have an appreciable effect, so much so that sheet iron is easily tested in this manner.

Based on this magnetic arrangement, it is theoretically possible to build an apparatus that will draw the desired curve and integrate it at one operation, so that the hysteresis loss may be read directly without calculation.

POSSIBLE IMPROVEMENTS IN THE SUPPLY OF ELECTRICAL ENERGY.

By S. Z. de Ferranti.

Seeing the position that the art of distributing electrical energy has attained to, and remembering the stages through which it has gone, I think that it may be well to look ahead, and to endeavour to work out the directions in which progress must be made.

The whole essence of improvement lies in the cheapening of the supply to bring it within the reach of all, and to adapt it to the many purposes for which it is so admirably suited. If we wish to attain to this, we must not be led away by looking at the matter in a narrow light, or considering the question from the standpoint of what is best in the immediate future. We must consider the question on the broad lines of the supply of a large and scattered area, such as is presented by almost all our towns, and this object must be achieved without the complication of a number of generating stations, which are but a clumsy makeshift on account of our defective knowledge.

Of the two systems, viz., alternating high tension with transformation, and low tension continuous direct supply, we have got to select that which meets the case most completely, and which gives the best promise of good results in the future. We must clearly not be misled by taking the system upon which it is easy to get the best results in the first instance, and which does not meet the real problem of electrical distribution.

Hitherto in this country the continuous and alternating systems have gone along side by side, though there is now a marked preponderance in the increase of the alternating. Usually the continuous current stations show better results in the way of cheapness of supply than the alternating current, and it is not hard to see that this should be so at the start. The continuous current stations have of necessity been put down in districts of small area, and in all respects suitable for electric lighting.

It stands to reason that to feed a small area it must be cheapest to do it by direct low tension supply, every transformation of energy, however perfect, involving some loss. As a result of this we have had station after station laid down which is incapable of extension, and systems have grown up which, until they are gradually changed, can never bring electric lighting, heating and power, to the position they will surely attain. The shortsightedness of this policy appears to have been lost to many engineers in their desire to follow what has, in the first instance, paid best, and to give to their clients that which will make the most remunerative investment at first.

But the possibilities of the low tension system, even when increased to the voltage of the five-wire system, are very limited, and almost every town that has adopted low tension is even now looking for a way out. They cannot extend to make their business large enough to be really commercial, and the sites of their generating stations are usually cramped, and in the worst and most expensive places for power generation.

Now, remembering our first point as to ultimate cost and its effect, let us see what is the first thing to be sought after to attain it.

The business of distributing electrical energy must be done upon a large scale to be commercial, and to attain this we must supply a large area not limited by the exigencies of systems, and we must do this from a site not in the congested heart of a big city, but from a position best suited by its natural advantages to the carrying on of such an undertaking.

This points clearly to the supply of current at high tension, and as the energy must be delivered to the consumer at a low pressure, it also points to transformation in some form or other.

As regards the distribution of electrical energy, we are therefore brought face to face with the fact that the only system which can completely meet conditions absolutely necessary to eventual success is the alternating high tension one. But of course this system, as is well known, leaves much to be desired in certain directions.

Cables are now being manufactured, at moderate prices, capable of taking such high pressures, that the question of the electromotive force used, from this point of view, is almost negligible. We have certainly succeeded most completely in transmitting high pressure currents by means of these cables, and there is little improvement which can be looked for in this direction. The only point where improvement is likely to be made is in using a voltage a good deal higher than that ordinarily used in present systems of electrical distribution, and I am quite satisfied that if the rest of the apparatus was capable of working well with a pressure of 5,000 volts instead of 2,000 or 2,500 volts, that there would be no difficulty from the point of view of the cables, and that this increased pressure could be supplied through cables costing practically the same money for the same sectional area, and, therefore, meaning that the sum invested in cables would be good for delivering a much greater quantity of energy to the consumers.

We next come to the question of the transformers, and this, of course, is undoubtedly the one seriously weak point in the alternating high tension system. Great improvements have lately been made in the manufacture of transformers, but it is principally in this direction which we must still look for improvement, both as regards manufacture, reduced maintenance, and a much greater percentage of energy sold than is at present possible. There is no reason why transformers should not be so improved as to enable them to sell as large a proportion of energy as is now sold by the low tension systems, taking into account the loss of energy in the feeders.

The distribution of the energy after transformation is also a point requiring attention. The cables for this are at present large, and therefore necessarily expensive, and the only way in which improvement can be made in this direction is to get to such a system of house wiring in the way of safety and certainty, as to enable a higher voltage to be used. Considerable improvements have already been made in the way of higher voltage incandescent lamps, but further improvement has also got to be made in this direction, which, together with a better system of wiring, would enable the capital expenditure in, and the annual loss on, distributing mains to be greatly reduced.

We now come to the question of what can be done at the generating station. There is here very great room for improvement. The apparatus forming the modern station is far too complicated in its many parts to be able to be run as cheaply as it should be, and this trouble is greatly added to by the large number of breakdowns due to that apparatus being in many cases of a most inferior quality, which in its turn is largely produced by the competitive tendering so much in vogue at present. Electrical engineers, and people who run electric light stations, have still got to learn that it is a matter of very small consequence to spend rather more capital on the plant in the station, and that the best plant that money can buy is none too good for the purpose.

What is most wanted in the way of improvement is to get such generating plant as will run with a better yearly economy, *i.e.*, which will produce a Board of Trade unit under varying conditions of output at a lower expenditure for coal, oil, maintenance, and labour. There is a very serious discrepancy between the tests on full load of electric lighting plants and the results given by a good station for a year's working, and in this direction engineers will have to work in order to improve the position of the business of electrical supply.

I think that a very fair increase of economy may be obtained by super-heating the steam running the engines to some 450 to 500° F., as a fairly lengthy experience on the Continent appears to have given very good results in this direction.

There is no doubt that the internal combustion engine will eventually be the cheapest and best motive power for use on a large scale in generating electrical energy, but, unfortunately, there is not to-day a single gas engine on the market which entirely complies with the every-day requirements of dynamo driving. Until this desirable end is achieved it will be necessary for engineers to work on improving the details, arrangements, and running of their steam plants by whatever means lie in their power. I think that there is still a great deal which may be done in the way of economy in this direction.

The station managers must still further pursue the question which many of them have already taken up, of getting a better load factor for their stations. This is the most important thing to cheapen the supply, and a cheap supply will, in its turn, react to make the demand greater. It will, no doubt, then be possible to further reduce the price of the current, which will react again beneficially in the production of a demand for current for other purposes.

These things, coupled with the achievement of some of the improvements which I have indicated will no doubt lead to a very widespread use of electrical energy, which it may be hoped will produce still greater improvements in the whole practice of generation and supply.

SUBMARINE CABLE GRAPNELS.

We are enabled this week to illustrate two new forms of grapnels which are just being introduced by Messrs. Johnson and Phillips, of Charlton, who, it is well known, make a speciality of all descriptions of apparatus for the laying and repairing of submarine cables.

The grapnels are the invention of Mr. Claude Johnson.

Fig. 1 is a sectional elevation of his patent collapsible grapnel for the recovery of cables lying on rocky bottoms. Fig. 2 shows its outward appearance.

In this grapnel the prongs are pivoted to the shank, and under normal conditions they project beyond the edges of the conical shield which forms the body of the grapnel. Should any of the prongs come in contact with rock they recede within the shield sufficiently far to enable the grapnel to clear the obstruction. The pivots of the prongs are so arranged that a very slight movement of the points is sufficient to bring them completely under the protection of the shield, and if a prong is forced back after the cable has been hooked it still retains the cable perfectly; as the prongs are arranged to collapse inwards the instrument is enabled to pass channels in which it would otherwise be held fast.

Fig. 3 is an illustration of patent grapnel for the recovery of cables in mud bottoms.

This grapnel has two steel prongs, which are comparatively

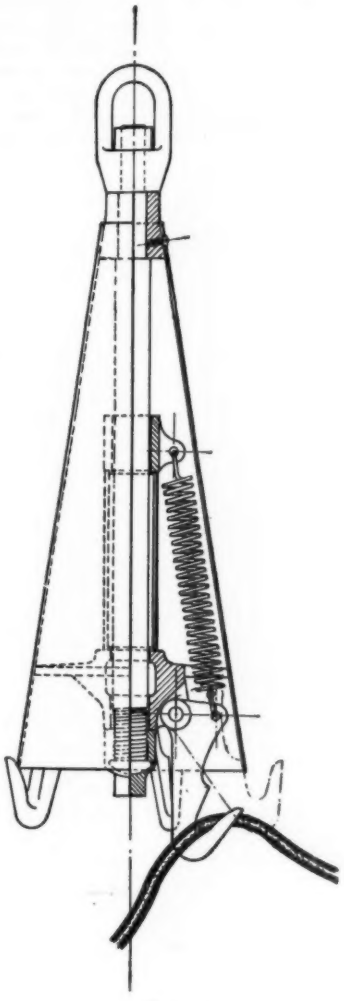


Fig. 1.

Fig. 2.

thin, but deep in section, so as to offer little resistance to their penetration into the mud.

The prongs are connected to one end of a broad flat plate, which constitutes the shank, the plane of which is at right angles to the plane of the prong.

On dragging with this grapnel the shank slides with its flat face on the surface of the mud, while the downward

Fig. 3.

directed prong penetrates to its full length into the mud, so as to seize the cable embedded therein.

Engineers engaged in the repair of submarine cables are well aware of the utility of grapnels which will drag rocky bottoms without injury to the prongs, and also of reliable grapnels for the recovery of cables of muddy bottoms.

CORRESPONDENCE.

Small Dynamo Design.

Referring to my inquiry of last week, I am sorry to find a mistake has crept in. The section of the armature core I should have put 4½-inch washers with a 2½-inch hole, instead of 4½-inch with 3½-inch hole. Therefore, it being 8 inches long, the section = 8 × 2 = 16 square inches,

$$E = n^t \times n \times z \times 10^{-6}$$
$$= 276 \times 1{,}600 \times \text{say } 300 = 132{,}480{,}000, \text{ and by } 10^{-6} = 132 \text{ volts.}$$

This comes out higher than we expected; but will the small section of the field magnets of which you speak alter the above calculations?

Anxious Student.

[The armature is, we now find, magnetically, much greater than the field, therefore the field strength is limited by the section of the magnet to a total flux of 190 Kapp lines. Allowing for leakage, your total flux will not be more than 170 through the armature, so that the greatest pressure you may expect will be equal to

$$E = 276 \times 1{,}600 \times 170 \times 10^{-6} = 75 \text{ volts.}$$

A good deal less than 105 volts. To get the section of your field and armature core, the flux should have been found by $\frac{E\ 10^{+6}}{N^t\ N}$, and 16 to 18 lines per square inch allowed in armature, and 10 per square inch in field core, if of cast-iron.—Eds. Elec. Rev.]

Re Small Dynamos: Their Construction.

I see by your issue of the 21st inst. that you are about to give useful hints and instructions to amateurs and others of a mechanical and electrical turn of mind for the home manufacture of a most useful and comprehensive machine developing about 1 H.P., and it has occurred to me that there must be several (I dare say many) of your readers who intend making such a machine, but do not possess a suitable lathe, and do not care about going to the expense of buying a lathe on purpose. And as in last week's Electrical Review you suggested that a founder should take up the manufacture of the magnets, I should like to ask that some one might take the armature in hand, as it is obvious that there are several little points in armature making that require extra care and nicety of construction to make a good mechanical job, and, also, many do not care about making them, being to them too tedious. Should it meet with the approval of the "Editors," I should be pleased to undertake this part of the machine, and in enclosing my card should wish to remain,

Walter H. Jackson, A.M.I.E.E.

[Mr. Jackson is at perfect liberty to offer the armature ready made, as he suggests. But if the amateur cannot make the armature, he cannot make any part of the machine; he may as well buy a machine ready made at once, rather than buy parts ready made, and put them together only.—Eds. Elec. Rev.]

Accumulators for Tramcar Traction.

Nothing could have been more welcome to me than your invitation to adduce additional proofs for my statements.

As regards the depreciation of batteries, the number of car miles run by means of accumulators of our make is such that even if the new plates were purchased at a price which includes manufacturing profit, the cost of renewal per car mile would only amount to ¾d.

That the first outlay is much less in an accumulator system than with long distance transmission is very easily proved; while, in the latter case, the plant must be of sufficient magnitude not only to supply the maximum energy required under the most favourable conditions, but must allow for a considerable reserve, with accumulators—the main reserve being represented by the extra batteries—the plant may be much smaller.

Turning to the cost of working, with a long-distance system the almost incessant variation of the load throws a heavy strain upon the machinery, and this, coupled with the necessity of keeping up extra steam for sudden emergencies, must increase the cost of working. On the other hand, with an accumulator system, the variations of the load are taken up by the batteries without direct reaction upon the generating plant, which, therefore, can always be worked at a uniform rate, and at or near its maximum output.

With a reliable type of accumulator and a sufficiently large number of cars, a battery reserve of 25 per cent. will be found ample. I agree with you in prefering a reserve of 50 per cent., as the additional outlay is comparatively small, and the security of working increased. It would, however, be quite unnecessary to go beyond that.

The difference in the weight of the batteries to which you allude is explained by important improvements in their make, which have been adopted without sacrificing anything of the reliability and longevity of our older types, as the construction of the parts which are mainly subject to deterioration has been retained.

Much stress has been laid of late upon the extra heavy expense caused by the wages for handling the batteries, and the deterioration of the cars, in consequence of the acid fumes. It is quite clear that a small concern, using only a limited number of cars, and presenting perhaps exceptionally unfavourable features, offers no proper criterion; besides, with light batteries, the cost of handling will be, in any case, much reduced. Acid fumes are mainly given off during the end of the charge, when the batteries are on the lifts, and not in the car. Any fumes given off during discharge can easily be rendered innocuous to the car by lining the accumulator space hermetically.

You refer, and it seems to me rather deprecatingly, to my January articles (in which I compared the different electrical traction systems) published in your paper. If the statements and figures which I advanced therein were not approved by you, may I ask why you did not correct them at the time, nor ever since, nor even throw any doubt upon them?

It may, however, be some satisfaction to you to know that the figures relating to the overhead and underground systems were not challenged by anyone else, although copies were sent to gentlemen interested in those systems, and their criticism invited.

That I vouch for the correctness of the figures relating to accumulator traction I prove by my offer to construct, equip and work approved lines at the cost indicated in my paper.

L. Epstein.

Explosions.

I read in to-night's paper that another terrible electric explosion has occurred in London. Would it not be advisable to draw the attention of electric light engineers to the suggestions I offered in the Review of January 10th and 17th, 1890, signed, "One Interested," with a view of remedying these awful occurrences?

Arthur E. Gilbert, A.I.E.E.

December 31st, 1894.

Electric Traction.

With reference to the note in your issue of the 21st inst., I quite understand that my recommendation of any particular form of electricity might not commend itself to those who know more about electric traction theoretically than I do practically.

Will you kindly accept the suggestion from me, that in speaking of the trials which it is proposed to make of the accumulators, the patents of which are owned by the International Electric Storage, Limited, I simply wished to convey to the Institution of Electrical Engineers my desire by all means possible to discover an economical system of tramway traction for the benefit of shareholders generally in tramway companies, and that consequently I was prepared to afford every facility for another trial of accumulators.

Will you allow me to say that, in speaking of the batteries as the Theryc-Oblasser, I should have added that the accumulators proposed to be used possess, I am informed, the advantages of these with many improvements thereupon, and are those known as the International Electric Storage D type battery.

W. J. Carruthers Wain.

Re "Wanted a Financier."

Last week you published a letter from "Obscure," who was wanting a financier for an invention which he had, and I have been anxiously waiting to see if there was anything more said about the matter in this week's paper. As I cannot find anything on the subject, I am afraid I shall have to fall back on my old opinion about this question of financiers for inventors who are so unfortunate as to be poor, which is, that there is very little hope for them ever to get anything by their inventiveness.

I think "Obscure" will find that his idea will not be worth anything at all to him, but, on the contrary, he will lose whatever he spends on it, and the better the idea the more certain he is to lose it.

Suppose he gets it patented and goes on to work it, as soon as it is known somebody is sure to copy it, or to take possession of it altogether. For, although there is not anybody to be found who will give anything for the thing by paying the inventor himself for it, there are plenty who will spend a few hundred pounds (if necessary) to get it by force in a patent law suit, and if "Obscure" has not their weapon—plenty of money—to fight with, he is pretty sure to lose.

There are one or two ways in which he can get a considerable amount of pleasure from his ingenuity. He can publish his idea to the world, and so be known and spoken of as the first to suggest the new process, or whatever it may be. But this plan will not always work, for as likely as not somebody will try to rob him of his pleasure by telling him that his invention has been described before. However, if that accident does not happen, he will be talked about for a time, and future professors will tell their classes that "This useful suggestion was first made by a Mr. Obscure, but he does not seem to have worked it himself, and nothing further is known of him."

A second way is to work out one's inventions, and make models or drawings, and then wait and see how long it is before somebody else brings forward the same idea. He will find it vastly interesting to compare his method with others and see how near he has hit the mark. I have tried this myself, and it works beautifully. Three years ago I worked out the idea of rectifying alternating currents for arc lighting by means of revolving commutators, and I find that the solution of the problem which Mr. Ferranti has put in use at Portsmouth and other places corresponds exactly with my own. Six months ago I thought out the idea of making use of wind power to store energy by compressed air. I have got a drawing of a horizontal mill which has eight vanes so arranged that the wind is always acting usefully on five of them, and the other three are turned edgewise to meet the wind, so requiring no shield as in Rollason's mill. This idea is just now being described by Mr. Rankin Kennedy; but I have gone two very important steps further than he has described so far. I have got five more schemes now which are waiting like lost children for somebody to adopt them. One is a governor for steam engines which will act with the variation of the load and before the engine has varied its speed the slightest.

Another is for keeping the volts practically the same in all the length of a street main—say, half-a-mile long—with tappings at intervals all the way, and the current density not less than 1,000 ampères per square inch of section.

The other three are not electrical schemes, and so are not interesting.

If "Obscure" will try this plan he will find he has not laboured quite in vain.

Harrow.

January 1st, 1895.

NOTES.

The Pacific Cable.—Negotiations are said to be going on between the English and French Governments by which the latter seek permission to extend the Australia-New Caledonia Cable to the Fiji Islands.

Communication with Lighthouses.—The Plymouth Chamber of Commerce considered the subject of electrical communication a few days ago. Mr. Bayly proposed that a memorial be forwarded to the Board of Trade, with a request that in view of the recent stranding of the *Dunottar Castle* on the Eddystone reef, steps may be taken immediately to establish electric communication between lighthouses and the shore. Mr. Bayly dwelt at considerable length on previous accidents which had occurred at this reef, and the resolution was afterwards adopted.

The Madagascar Cable.—The French Government has at length concluded a contract for the manufacture, laying, and maintenance of a submarine cable from Mozambique to Majunga, on the western coast of the Island of Madagascar. It will be remembered that this time last year the Government asked for tenders for the immediate construction of a network of cables extending from Mozambique to Majunga, Nossi Bé, Mayotta, Diego Suarez, Tamatave, St. Marie, Reunion, and Mauritius, and its maintenance by means of a repairing steamer to be kept on the spot. This elaborate scheme has now been reduced to a 390-mile section between the two ports above-mentioned. The contract for the manufacture has been equally divided between the hitherto rival French companies, Grammont & Co., of St. Tropez, and the Société Industrielle des Téléphones, of Calais, and the works at both places are now busy. The laying is to be carried out by the *François Arago* cable ship, belonging to the last-mentioned company, under the supervision of the engineer of the former company, and is to be completed by April 1st next, under heavy penalties. We shall look forward to hearing a little more of the history of this cable at some future time. It is stated that the terms of the contract are considerably higher than offers which have been made by English firms.

The Growth of Electric Lighting at Hull.—The Corporation have now 268 electric light consumers, against 134 at the end of 1893.

Our Central Station List.—The information concerning the London Electric Supply Corporation contained in our Central Station List was, through no fault of our own, very inadequate, and we have pleasure in supplementing it by the following:—

Belgravia and Pimlico, Mayfair, Westminster, Chelsea, St. George's, Hanover Square, St. James's Parish, St. Martin's-in-the-Fields. Lambeth—St. George the Martyr, St. Saviour, Southwark, Newington, St. Olave's Board of Works, Bermondsey, Greenwich. London Electric Supply Corporation. High tension system, generated at 10,000 volts, distributed at 2,400 volts to house transformers, and thence to the lamps at 100 volts. Engines by Hick, Hargreaves and Co., and Plenty & Co. Babcock & Wilcox boilers. Ferranti dynamos. Green's economisers. Ferranti, Siemens, Fowler-Waring Company and British Insulated Wire Company's cables. Distributing stations at Belgrave Mansions, Ebury Street, Bloomfield Place, New Bond Street, Cockspur Street and Blackfriars Road. Total lamp connection for all parishes 72,000; added during last four months 4,000.

The following paragraph also brings the Crystal Palace Company up to date:—

There are now eight sub-stations, in each of which there is a battery of accumulators. The number of incandescent lamps connected on consumers' premises is 7,315 8-candle-power, that is, 3,402 lamps added during the year, and 25 arc lamps, or 10 added during the year. The total capacity of station is 28,000 8-candle-power lamps. Total outlay £73,000 approximately.

The Chloride Accumulator.—The *Electrical World* says:—"The Electric Storage Battery Company announces officially that it has acquired all the patents and patent rights concerning the manufacture of electric storage batteries of the General Electric Company, the Edison Electric Light Company, the Thomson-Houston Electric Company, the Brush Electric Company, the Accumulator Company, the Consolidated Electric Storage Company, and the General Electric Launch Company, whereby the Electric Storage Battery Company has secured to itself the sole right to supply in the United States electric storage batteries of all the various important types heretofore developed, as well as the protection of every decision heretofore rendered by the United States courts in the interpretation of electric storage battery patents. The acquisition of these patents, the company states, not only terminates all litigation heretofore existing, but insures against any future attacks, as the patents acquired, together with those originally owned by the Electric Storage Battery Company, cover all the known principles involved in storage batteries. It announces that it has also increased largely its cash working capital, and is now fully prepared to fill all orders for storage batteries."

Commenting on the foregoing, our contemporary states that:—"An official announcement has finally been made by the Electric Storage Battery Company, of Philadelphia, in regard to the acquirement by it from various sources of the fundamental storage battery patents. As foreshadowed in these columns last week, there is no consolidation of the various interests of the storage battery companies concerned, as has been erroneously stated, though the resulting situation is such that there will undoubtedly be a friendly co-operation in the future. The deal consisted in the transfer to the Electric Storage Battery Company of all the patents and patent rights relating to the manufacture of storage batteries that were held by the General Electric, Edison Electric Light, Thomson-Houston Electric, Brush Electric and Accumulator, Consolidated Electric Storage Battery, and General Electric Launch Companies. This carries with it the sole right to supply in the United States electric storage batteries of the various important types heretofore developed, and includes the protection of the several important decisions rendered in the United States Courts in interpretation of electric storage battery patents. The acquisition of these patents will, therefore, not only terminate the litigation which has heretofore had such deplorable results, but as all of the fundamental patents on storage batteries seem to be now included under one ownership, there is consequently a good prospect that the industry will have the free development which has been denied it in the past. The business methods employed in the past by the company now in control in its management of the chloride battery have been of such a character as to lend further assurance of the accomplishment of this long-deferred hope."

The Institution of Electrical Engineers.—On Thursday, January 10th, 1895, the council meeting will be held at 7.0 p.m., and the ordinary general meeting at 8.0 p.m., when the inaugural address of the President, Mr. R. E. Crompton, M.Inst.C.E., will be given.

The Welsbach Light.—Our New York contemporary, *Electricity*, who has gone very thoroughly into the matter of the Welsbach gas light, is convinced that it is but a short-lived competitor, but that it *is* a competitor is beyond question. "Further investigations made furnish added proof that our analysis of its weaknesses was correct. The Welsbach burners were tried and discarded in the large dry goods house of Bloomingdale Bros., because of the extremely short life of the hoods, and the fact that the quality of light began to deteriorate after a few hours' burning, rendering new hoods necessary long before they were broken. Attempts to clean them resulted in a breakage of 40 per cent. of the hoods. They were tried in the show rooms of Dorflinger Bros., the leading American cut-glass makers, and would have ruined the business of the company if they had been long continued. The purest and whitest of the product was made to look as green as the cheapest grade of window glass, and the electric light was soon reinstalled."

Aluminium Leading-In Wires for Incandescent Lamps.—A plan to replace platinum by aluminium, to the use of which metal objections based on rarity are not now very likely to apply, has been suggested by Mr. Werner Bolton, who exhibited lamps made with the substitute at the recent meeting of the German Electro-Chemical Society in Berlin. The coefficient of expansion of aluminium is much larger than that of glass, and direct sealing-in is impracticable. The joint between glass and metal is, however, made in the following ingenious manner. The aluminium is heated, says the *Electrical Engineer* of New York, in a glass tube until it fuses, and the envelope of glass fuses round it. When the composite rod (having a glass envelope and an aluminium core) cools, the glass cracks; but this is of no moment, as the function of the glass is merely to prevent the aluminium melting when it comes to be sealed into the thick glass envelope which ultimately forms the base of the lamp. The arrangement is shown at fig. 1, where the

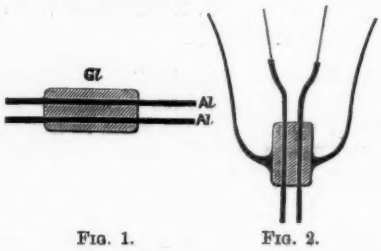


Fig. 1. Fig. 2. Fig. 3.

aluminium wires, *Al* (about 3 cm. in length), are fused into the thick glass envelope, *Gl*. The glass envelope carrying the wires is shown sealed into the lamp in fig. 2, which needs no further explanation. The joint between the glass and the aluminium is made tight during the exhaustion of the lamp in the following manner:—It is a well known fact that aluminium when amalgamated by contact with a solution containing mercury, oxidises rapidly, becoming covered with the oxide alumina, in the form of a dense powder. This incrustation of oxide, if caused to occur between the aluminium wires and the glass into which they are sealed, is said to make an air-tight joint. These properties are given effect to by applying a drop of a strong solution of mercuric chloride to the outer ends of the wires during the exhaustion of the lamp. The liquid is sucked in between the wires and the glass, and causes the amalgamation of the surface of the metal and its consequent oxidation, the oxide being tightly enclosed and forming an air-tight lute. As soon as the joint is tight the ingress of air is, of course, prevented, and oxidation ceases. Should a small leak occur it cures itself by the action of the oxygen on the remaining aluminium amalgam, resulting in the production of a further supply of luting material (alumina) precisely at the point where it is needed. The aspect of the wires with their coating of alumina, *o*, *o*, *o*, is shown in fig. 3.

The Electrical Trade in Scotland.—It would appear from the *Glasgow Herald* that the electrical trade in Scotland has been fairly satisfactory during 1894. The growth of the electric lighting scheme of the Corporation has been greater than its promoters expected, and it is suggested that a second station will be required very soon. Our contemporary also notes the fact that electricity in mining work has gone ahead.

Finsbury Park and City Electric Railway.—The Great Northern and City Railway Company are not getting on with their electric railway. They are asking Parliament to extend the time from June, 1895, to June, 1897, in which to purchase land, and a further extension until 1900, within which to open the line for traffic. If this company is anxious to do any business this century, it must make a little more progress.

A Rat Causes an Electrical Fire.—A singular accident occurred recently to the electric lighting system of Baltimore. The lights of a large portion of the city suddenly went out with no apparent cause, many connections were burnt out, and the switchboard was found to be badly damaged. It was finally discovered, says the *Scientific American*, that the trouble was caused by a rat which had chanced to step from one copper terminal to another, thus short-circuiting the current. The rat's body was wet at the time, thus making it a good electrical conductor. The rat's hair was burned off, and the body had become rigid as if frozen. This accidental connection of the terminals caused a sheet of flame to spring from one set of terminals to the others, which burned off the rubber insulation of the wires, leaving them exposed, and set fire to the woodwork near them. It was found necessary to replace all the wires on the switchboard before the circuit could again be operated.

Electric Lighting at Brighton.—The Municipal Authority talk of extending the public lighting to Marine Parade, but the proposition has called forth many protests, which has taken the form of correspondence in the *Sussex Daily News*. The most vigorous remarks come from a lady, who says:—

Sir,—I am very glad to see that the extension of the electric light on the Front does not meet with universal approval. I am sure, whoever first proposed the extension, could not have consulted his wife and daughters, for a more disastrous light for the complexion could not be devised. It positively makes one look ghastly, and if it could be abolished the women of Brighton would have much for which to be thankful. Not only does it make one look blue, but it makes one feel horribly cold, even in warm weather, and a walk along the Front is attended with a feeling of chilliness which is most unpleasant. If anything can be done Mr. Editor by you to keep the electric light off the Western Road please do it, and I am sure you will earn the thanks of the majority of the ladies of Brighton.

Yours, &c.,

ONE OF THEM.

Brighton, *December 27th.*

We can assure the ladies of Brighton that they do themselves an injustice when they suggest that they should walk about the Marine Parade in the dark.

Société d'Encouragement pour l'Industrie Nationale.—The Society offers the following prizes for the year 1895: Grand prize of 12,000 francs to the author of the most useful discovery for the improvement of French industry. Prize of 2,000 francs for a motor of a weight less than 50 kilos. per horse-power. Prize of 1,000 francs for a motor burning heavy oils. Prize of 3,000 francs for a motor of from 25 to 100 horse-power, expending at most 7 kilos. of steam per hour and per H.P. indicated. Prize of 2,000 francs for a small motor for a domestic workshop. Prize of 2,000 francs for a study of the coefficients necessary for the mechanical calculation of an aerial machine. Prize of 1,000 francs for the best treatise on the cost price of motive power from steam. Prize of 2,000 francs for a publication useful to chemical industry. *General conditions to be observed in the competition.*—The models, memoirs, descriptions, instructions, specimens and articles destined to prove the rights of the competitors must be addressed to the secretary of the Society, No. 44, Rue de Rennes. The detailed programmes of the prizes, with all the instructions necessary for competitors, are to be obtained free at the offices of the Society. All the articles deposited remain the property of the Society.

Light and Heat on Exhibition.—An exhibition to illustrate improvements in lighting and heating will be held next May at Wodehouse Park, Shepherd's Bush. Among the men of light and leading on the committee are Lord Rayleigh, Mr. W. H. Preece, and Captain Abney.

The City and South London Railway Extensions.—This company will next session ask Parliament for an extension of time, to July, 1901, in which to complete the railway to Clapham Common. The company also seek power to raise £40,000 additional capital, £30,000 as preference, and £10,000 as debenture stock.

A Suit Against the E.C.C.—An Indian contemporary contains the following:—"It is said that the Madras Tramways Company has filed a suit against the Electric Construction Company, Limited, in England, for heavy damages on account of delay in completing the contract with respect to the construction of the Madras Tramways."

The Liverpool Corporation and the Local Electrical Company.—At the meeting of the City Council, held on Wednesday, the Special Lighting Committee were to recommend the purchase by the Council of the business of the Liverpool Electric Supply Company, also that the committee be allowed to formulate a scheme for the supplying of electric lighting to all the public buildings and markets.

Messrs. W. T. Glover & Co.—Mr. Henry Edmunds, the only surviving member of this well-known company, has taken into partnership Mr. Godfrey Blundell Samuelson, the son of Sir Bernhard Samuelson, Bart., M.P. The style of the firm will remain W. T. Glover & Co., as heretofore. We accord to Mr. Edmunds and his partner our best wishes for the future.

Plans for the Paris Exhibition.—The jury entrusted with the task of awarding the prizes offered by the French Government for the best designs for the projected exhibition building in Paris in 1900 gave their decision a few days ago. The first prize of £240 was given to M. Henard, whose design includes an enormous dome, connected with various other buildings by means of an overhead electric railway. The second prize was awarded to M. Girault, who chiefly devoted his attention to the organisation of a colossal Venetian fête on the Seine, in which coloured electric lights are to play an important part.

Progress of Electric Lighting in Bristol.—The *Western Press*, in a review of local events of 1894, says that:—"The electric light has now been installed at Bristol just over a year, and it has been so much appreciated that the Electrical Committee have received numerous applications for extension beyond the limits agreed upon by the Council. Several of the city churches and many public buildings are now lighted by electricity, and the demand for the new illuminant for business purposes has been equal to the most sanguine anticipations. Other districts of the city, not included in the prescribed area, are looking forward to a period when the committee will be in a position to recommend important extensions."

The Electric Light at Chelmsford.—We cull the following note from the *Essex County Chronicle*, which cannot be considered complimentary to electric lighting:—"The Chelmsford Electric Lighting Company, in response to the petition of the consumers of electricity in Chelmsford, asking that the electric supply should be continued for as many hours as possible during the dark days, state that they will endeavour to meet the request as far as lies in their power. It is absolutely necessary, however, to turn off the electric current for at least one hour a day for testing purposes, and for a longer period than this for a few days for the purpose of connecting new customers to the system. Instructions have been given to the engineer to keep on the supply every morning until he finds the current leaving the station falls below a certain fixed limit, and that the supply is then to be turned off gradually, so as to give ample notice to those using the few lamps which are still burning. The fixed hours during which the current will be turned off every day will be from twelve to one."

Continuous Current Dynamos.—Mr. C. C. Hawkins, in *Science Progress*, continues in Part II. his history of the Dr. Hopkinson contributions to the science of continuous current dynamos. Sayers's compensating armature winding is referred to as the greatest of late advances in dynamo design. The largest continuous current dynamos of two-polar design are said to be at Carnaby Street power house of the St. James's and Pall Mall Electric Light Company. The armatures are triple wound, the three windings feeding into two sets of brushes in parallel, the machines working successfully without heating or sparking. The multipolar slow speed dynamos, as applied in Continental power houses and the power houses of American electric railways, are described briefly, without going into any detail. High pressure continuous current dynamos are also mentioned, the limit in practice being stated at 2,000 volts, a pressure which can be exceeded only by connecting them in series. The paper is chiefly historical, and the author proves that the continuous current dynamos are doing immense work, and that their design and construction has reached an advanced stage of perfection.

Quartz Fibres.—The fine fibres which Mr. C. V. Boys manufactures out of molten glass and quartz by an ingenious process, which is probably familiar to most of our readers, are claimed by him, and admitted by most, to possess properties which render them more suitable for certain experimental work combining delicacy and accuracy, than those of other known materials. The method of fastening them, however, which has usually been adopted, leaves much to be desired. Consequently, Mr. Boys, with his customary thoroughness, has specially investigated this apparently simple matter, and has communicated the results to the last issue of the *Proceedings* of the Physical Society. Those who intend in their electrical work to make use of these fibres, had better consult the very full and lucid directions given by Mr. Boys on pages 69—71 (Vol. xiii., Part I.), for much as we should like to condense them for our readers, they would only suffer by the operation. Here the whole process of silvering, electro-coppering and soldering is minutely explained, and directions are specially given for treating the fibres in cases where they are required to conduct electricity, as, for instance, in keeping the needle of a quadrant electrometer electrically connected with a battery. It might be thought that the silvering of these fibres would destroy their perfect elasticity, but this is not found to be the case, as indeed might be inferred from the fact that both silver and gold make very good torsion wires.

Prof. Jamieson and the Alleged Electrical Discovery.—The great discovery which was to make Scotland famous has received a severe blow, as will be seen from the following cutting:—"Prof. Jamieson, of the Glasgow and West of Scotland Technical College, son of Rev. Dr. Jamieson, of Oldmachay Cathedral, being at present at home for his Christmas holidays, the *Aberdeen Journal* took the opportunity of asking his opinion about the value of the 'primary battery' alleged to have been invented by two Clydebank youths. Prof. Jamieson declared it was physically impossible to obtain more than a well-known output in ampère-hours per pound of zinc used in any primary battery, and, further, that he has proved that it was impossible to produce 1 horse-power-hour by the simple chemical elements used in the battery in question (zinc, sulphate of copper, and copper) for less than 30 times the price at which it can be developed with a good steam engine and dynamo. He added that for the last 3½ years a successive series of tests had been carried on in his electrical engineering laboratory at the Glasgow and West of Scotland Technical College on the latest and best primary batteries, both of the wet and of the dry type; and that the two best of the former kind were the Obach and E.C.C. cells, whilst the new Walker-Wilkins non-polarising wet battery gave a return in ampère-hours of 97 per cent. efficiency of the theoretical possible output per pound of zinc in the battery. The professor pointed out that, consequently, any future would-be inventor using zinc as the electro-positive element in the cell would find it difficult to surpass such results, and the public should beware of investing their money in anything of the kind that has not been thoroughly tested by impartial experts."

Magnetostibian: A New Magnetic Antimony Ore.—A new mineral containing antimony has been found in the Sjö mine, Scandinavia, and is described by L. J. Igelström in the German paper, *Zeit. Kryst. Min.*, xxiii., p. 212. In appearance the mineral closely resembles magnetite and jacobite, but differs, however, from them in being red and transparent when viewed in their section under the microscope. It occurs in the form of grains in limestone, and its constitution is expressed by the chemical formula $(Mn\ O, F_2\ O)_{55}, Sb_2\ O_5$. The properties of this mineral are of a highly magnetic character.

Meeting of the Société Internationale des Electriciens.—At the meeting held on December 5th, M. Boucherot gave some particulars of the new installation established at Messrs. Weyher and Richemond's works at Pantin (Seine), for the distribution of motive power, and for lighting. The installation is arranged with diphased currents, on account of the many advantages that these currents present as compared with continuous currents. He quoted several figures with regard to the efficiency of the generators, motors, and the various apparatus driven by them. Lastly, he remarked that if the company had chosen diphased currents, it was because they had found out their advantages, for they constructed both continuous and alternating current apparatus. The present installation comprises a horizontal steam engine of 400 H.P., at 60 revolutions a minute, working by transmission a continuous current exciting dynamo, 1 triphased current alternator, and 3 diphased current alternators of 88 kilowatts at 400 revolutions per minute. These alternators feed 60 arc lamps and 600 incandescence lamps, and also 17 motors of a total power of 190 kilowatts distributed through the works. The total industrial efficiency of the installation amounts to 78·5 per cent. at full load. M. Ch. Ed. Guillaume then gave some particulars as to the elastic coupling of machines, and showed by means of an apparatus designed for the purpose, that the practical working of this coupling was very satisfactory. M. Vuilleumier described the system of electrical tramway with underground cables which he has installed, and which has been working for several months at the Lyons Exhibition. This system is based on an automatic method of distributing the electrical energy to rails separated for a moment at the time the car is passing. A simplex gas engine of 120 H.P. works a Thury dynamo of 500 volts and 200 ampères. The cost of installation would amount in Paris to 21,000 francs per kilometre, and to ·20 francs per car kilometre for 10 cars travelling 100 kilometres a day. An extraordinary meeting was held on December 18th, when M. J. Voisenat presented Elisha Gray's telautograph. The principle of this apparatus is well known; we need not give a description of it here.

Charity Begins at Home.—"Prof. ——, a medical electrician, known in Australia and New Zealand, has very charitably consented to attend at L—— for five days, when the deserving poor of that town who require treatment by his unique method will be attended to free of charge. Prof. —— is a specialist in scientific medical electricity." Such is the purport of an advertisement and editorial note we saw in a provincial paper the other day. This public benefactor has, it seems, acquired fame in the Australian Colonies, but as to the nature of that fame, whether good or ill, we dare not guess, for we are only told that he was "known" there. To this we would like to add that other men in a similar line of business, even in England, are better known than the so-called charitable professor. But just one question. What is the professor's *unique* method? It would be interesting to know. In our issue for May 4th, 1894, we published a note regarding a quack passing as "Professor," who had been at work in Nelson (New Zealand). An assistant publicly exposed his employer's artifices, whereupon, being threatened with actions by angry dupes, the professor secretly fled from that place, and sought business in the south. Far be it from us to suggest that this incident has any connection with the kind professor who has now come to visit us, but we would just like to inform him, if he does not already know it, that in a certain country mansion, shut away from the temptations and troubles of the outside world, exists a quack, enjoying without any expense a change of air and a change of occupation, which he will continue to enjoy until five years from March last have passed away.

Gas Engines.—Messrs. Robey & Co., of Lincoln, have constructed an improved form of the Robey-Girder frame gas engine of 100 effective horse-power. It is another example of the growing size and rapid extension of large gas engines, and there is but little doubt that these powerful motors will in the near future play a very important part in the electric lighting industry. Indeed, the conclusion of Mr. Ferranti's article clearly points to this.

Early Morning Telephone Tests.—In our issue of November 28th, we reproduced an article by Mr. J. W. Manson on "The Early Morning Test in Telephone Offices," showing a method whereby time is saved and the lines are all tested when the men come on duty. Robert C. Matlock, of the Mgr. Central Union Telephone Company, writes to the N.Y. *Electrical Engineer* as follows on the subject:—"It does not seem to me that this mechanical test should be applied to line and instrument. For the operator to merely know that his test shows the line open or closed does not seem to be the test we desire, and I am a firm believer that the best test that can be made is to call the subscriber to his instrument and have him give the usual 'ring' back. This tells us whether his line is in working order, and also whether or not his instrument is working satisfactorily. To merely ascertain whether the line is open or closed tells us nothing, and gives us no information relative to the working of his instrument, or whether he is satisfied with its working. I believe it good policy to give the patrons a chance to speak for themselves, and not depend too much on mechanical tests. I do not think that employés should be kept idle waiting for the test records, and I have yet to see the exchange where there is not something to keep the men busy. There is no reason why every business telephone should not and cannot be tested by at least 7.45 in the morning, and in the majority of exchanges I believe they are. Residence telephones can be tested at a later hour if so desired. At this exchange, our test records are always in the hands of the chief operator at 8 a.m., and trouble slips are made out as fast as the trouble shows itself. I think a little attention to this work on the part of the operators facilitates the test, and does not make it a burden to anyone, and we derive the best results from a personal test with the subscriber or his employé, and this cannot come from a mechanical test. The more attention shown telephone patrons the better are the results and harmony, and a good working exchange must follow."

Mr. J. W. Manson has replied to the N.Y. *Electrical Engineer* as follows:—"In your issue of the 12th inst. I notice a letter criticising my article on the 'Early Morning Test in Telephone Offices.' It is evident that the writer, Mr. Robt. C. Matlock, cannot have read the article very carefully. His letter implies that I advocated the abandonment of the regular morning test by the operators, and the substitution of a 'mechanical' method incapable of telling anything about the condition of the instruments in subscribers' offices. I regret the necessity of pointing out that my language in this regard was perfectly clear, and could not bear such construction. In the first sentence I referred to the regular morning test as one that 'well repays the trouble taken,' and a moment later as 'indispensable.' I fail to comprehend how anyone could have misunderstood statements so simple. Yet that is what Mr. Matlock has done, and his subsequent description of the good features of personal testing is quite superfluous, as no one has ever called them in question. The objection which I made to the regular test was, that it is not complete till the majority of the subscribers are at their places of business. The mere fact that local conditions may make the business day begin at an early hour, is nothing to the point. In making the assertion that business telephones can be tested by 7.45 in the morning, he betrays his want of familiarity with the conditions prevailing in large cities, where few offices are open till long after that time. Admitting that the operators' test sheets are in the hands of the chief at eight o'clock, and presuming that the day force reports for duty at 7, it follows that one hour is spent in making tests. Unless troublemen are sent out on the mere word of the operators, the chief must make further tests on the lines reported, before distributing the work. All this means delay, and to say that troublemen have found 'something' to do in the interval does not dispose of the fact that subscribers' lines were out of service while the men were otherwise employed."

New Year Honours.—Mr. J. C. Lamb, C.M.G., Assistant-Secretary to the Post Office has been made a C.B.

The Explosion in Euston Road.—The Board of Trade will hold an inquiry into the facts concerning the explosion at the St. Pancras Vestry Hall next Thursday at 10 a.m.

The Engineer for Worcester.—Three candidates were brought by the Electricity Committee before the Council, but owing to a misunderstanding, the matter was referred back.

The Niagara Machines.—Our contemporary, *Nature*, published in its last issue a view of the 5,000 horse-power generators employed at Niagara.

Institution of Civil Engineers.—This Institution, which was established on January 2nd, 1818, and incorporated by Royal Charter on June 3rd, 1878, now consists of 6,660 members of all classes.

"The Technical World" and "Science and Art."—Messrs. Whittaker & Co. issue the first number of a popular penny weekly on January 5th. The new journal will embody the combined features of the *Technical World* and *Science and Art*, two periodicals which have hitherto appeared as separate organs.

Electric Light at Cardiff.—On New Year's evening the electric light was switched on in the main streets of Cardiff. The light given was brilliant, and for the first time the gas in the ordinary street lamps were dispensed with in the area served by the electric light.

Applications for Provisional Orders.—We publish this week a fair number of applications for provisional orders; unfortunately provisional orders cannot be considered a real criterion of the progress of electric lighting. Of those given on another page, 14 are from joint stock companies and 14 from local authorities, which rather shows that municipal enterprise is declining somewhat.

The Lighting of Public Buildings.—The constructors or decorators of public buildings have yet to learn a good deal concerning the best means of lighting, particularly when using electric lamps. The magnificent Queen's Hall is, perhaps, the best and the worst lighted building in London at the present moment. It is the best by reason of the great illumination, but it is bad on account of the excessive glare, especially when looking at the orchestra. Decorators should remember that they do not obtain the best visual effect when a great light strikes the eye.

Trade in 1894.—Messrs. Matheson & Grant, in reviewing in the *Times* the engineering trade during 1894, say there has been a continued demand for electric lighting plant, not only at home, but also for export, and much good work is done by those who, having had experience as makers of steam engines, have added the manufacture of special electric appliances. The increase in the number of large installations for town supply encourages a demand for the highest class of steam engines and boiler equipment.

Portsmouth Electric Lighting.—At the meeting of the Portsmouth Town Council on Tuesday, the electric lighting committee asked permission to extend the electric light mains, at an estimated cost of £3,056, forming part of the £20,000 already voted by the council. Alderman Ellis, chairman of the committee, stated that he had that morning received the figures for the half-year's working, and for six months the revenue had been £3,228 11s. 9d. The expenditure on coal, labour, and salaries, was £1,773, but this included a quantity of oil and coal still in stock. The gross profit, subtracting expenses from income, was £1,455, or sufficient, had they been a private company, to declare a dividend of 5 per cent. He had no hesitation in saying that, from a commercial point of view, they had done better than any other town in England. The committee's recommendation was adopted.

The Hermite System of Sanitation.—We have received a pamphlet on this subject, written by Mr. E. J. Paterson, which is practically a reprint from the *Surveyor*. This subject has been so fully discussed in this journal, that it is not necessary at the moment to refer to it again.

Air Compressors.—It would not be amiss if some manufacturer, who makes a speciality of air-compressing apparatus, were to carry out experiments on the lines indicated in Mr. Rankin Kennedy's recent articles. There is more in his suggested air storage for electrical purposes than appears at first sight.

Lighting of Leeds Municipal Offices.—Some time ago the Corporation, desirous of abandoning the old plant in the municipal offices, entered into negotiations with the Yorkshire House-to-House Company for a supply of electricity. The matter has, however, been delayed, but we understand that further negotiations are now proceeding.

Storage Batteries.—Mr. E. Hancock, whose letter appeared in our last issue, writes to say, a week too late, that his remarks on storage batteries were really not intended for print. He would rather encourage Mr. Epstein than throw cold water upon him, and he thinks the step he has taken in reducing his cells to three plates is in the right direction. He adds, "The 10 per cent. was intended to refer to the potential drop at E.P.S. rate against his higher," whatever that may mean.

Personal.—Dr. J. Russell Reynolds, who is one of the newly created baronets, is a distinguished *alumnus* of London University, where he graduated M.D. with honours in 1852. He is a Fellow of University College, a Fellow of the Royal Society, and of numerous other scientific and medical societies. For many years he has been Physician-in-Ordinary to Her Majesty's Household, and Consulting Physician to University College Hospital. He is the author of "Lectures on the Clinical Uses of Electricity," and of other works.

The Products of Salt Electrolysis.—Some improvements relating to the methods of dealing with the products set free in the electrolysis of salt solutions have been devised by the Compagnie Electro-Chimique de St. Béson. The chlorine and the soda solution being brought together outside the electrolytic apparatus, are employed in the manufacture of hypochlorite of sodium, or else the chlorine being given off, is converted into various useful derivatives, whilst the caustic soda is dealt with separately. In the latter case the soda is mixed with litharge in a digester, mechanically agitated and heated; the hot solution is then carbonated, with the result that insoluble white lead is precipitated, and afterwards separated off by means of a filter press. The alkaline liquid is further carbonated for the production of insoluble bicarbonate in solution of sodium chloride, the mother liquor being afterwards returned to the electrolyser.

NEW COMPANIES REGISTERED.

Andrews Foreign Syndicate, Limited (42,854).—This company was registered on the 22nd ult. with a capital of £4,000, in £1 shares, to acquire by purchase the patented invention of J. D. F. Andrews and J. C. Andrews, for improvements in electric conductors and joints for electric lighting, to carry into effect a certain contract to that end, and to do everything to develop the properties of the company. The subscribers (with 1 share each) are: E. H. E. Hensley, 3, Crown Court, E.C., gentleman; H. T. Stanes, 5, Laurence Pountney Lane, E.C., merchant; H. W. Ball, 105, Fentiman Road, S.W.; W. Goslett, Bexley Heath, commercial merchant; T. D. Cox Parker, 20, Abchurch Lane, E.C., gentleman; J. S. Callingham, Fulham, accountant; J. Baltus, Clapton, clerk. Table "A" mainly applies. Registered by Wm. Goslett, 13, Eastcheap, E.C.

Universal Electrical Fittings Company, Limited (42,881).—This company was registered on the 29th ult. with a capital of £6,000, in £1 shares, to carry on the businesses of metallurgists, metal founders, metal workers, wood workers, tool makers, electrical instrument makers, electrical contractors, manufacturers of or dealers in, or affixers of dynamos, lamps, meters, transformers, conductors, and any kind of electric materials or things in connection with electric lighting or traction, telegraphs, telephones, or any other branch of electric work. The subscribers (with one share each) are:—G. Franklin, 5, Broad Street Avenue, E.C., accountant; H. S. Ayres, 43, Dunsmore Road, N.W., clerk; C. Field, 10, Estelle Road, N.W., clerk; A. Le Lofes, 12, Priory Road, W., caterer; F. Hobdon, Lewisham, cashier; W. H. Chantrey, 3, Cambridge Gardens, S.W., clerk; J. G. Godwin, 3, Mornington Road, Bow, clerk. The qualification of a director is 10 shares; remuneration to be fixed in general meeting. Registered office, 75, Carver Street, Sheffield, Yorkshire.

Silveroid Company, Limited (42,883).—This company was registered on the 29th ult. with a capital of £400 in £1 shares, to carry into effect a certain agreement for the working of a secret process for the electrical deposit of silver upon brass, copper, and other metals usually electroplated, made September 29th, 1894, between C. H. Woolf and A. E. Hayman, both of 78, Fleet Street, E.C., journalists, and others. The subscribers (with one share each) are:—S. St. J. Steadman, 23, Old Broad Street, E.C., solicitor; H. G. Campion, 23, Old Broad Street, E.C., solicitor; H. S. Simmons, 23, Old Broad Street, E.C., solicitor; F. Orme, 23, Old Broad Street, E.C., solicitor; W. H. Robson, North Finchley, clerk; G. G. Hay, Ellerslie, Harlesden, clerk; E. W. Pidgeon, Stratford, clerk. Registered by Steadman, Van Praagh Sims & Co., solicitors, 23, Old Broad Street, E.C.

Gilbert Gilkes & Co., Limited (42,887).—This company was registered on the 31st ult. with a capital of £20,000, in £10 shares (650 preference and 1,350 ordinary), to acquire and carry on the business carried on by Gilbert Gilkes, under the style or firm of "Gilbert Gilkes & Co.," as civil, mechanical, and electrical engineers, at the Canal Ironworks, Kendal, Westmoreland. The subscribers (with 1 share each) are: G. Gilkes, Lynnside, Kendal, civil engineer; E. Crewdson, 7, Norfolk Street, Manchester, accountant; R. E. Gilkes, Lynnside, Kendal, married woman; D. J. Pennington, Kendal Green, civil engineer; N. F. Wilson, Canal Ironworks, Kendal, civil engineer; F. Wilson, Kendal, manufacturer; R. W. Pennington, Kendal, draughtsman. The first directors are G. Gilkes, D. J. Pennington, and N. F. Wilson; qualification, £1,000. Registered office, Canal Ironworks, Kendal.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Rugby School Electric Lighting Company, Limited (39,309).—This company's annual return shows that out of a nominal capital of £5,500 in £50 shares, 70 shares have been taken up, and that £32 has been called on each of these. A sum of £2,144 has been received, and £96 is outstanding.

Bourne & Grant Electricity Supply Company, Limited (38,854).—A notice filed at Somerset House shows that the nominal capital of this company has been increased by the addition of the sum of £20,000, divided into 20,000 ordinary shares of £1 each, beyond the registered capital of £25,000.

District Messenger Company of Paris, Limited (39,302).—At a meeting held on November 29th, 1894, it was resolved that the above company should be wound up voluntarily. Mr. A. W. Barr, of 30, Moorgate Street, E.C., accountant, was appointed liquidator.

Electric Motive Power Company, Limited (41,132).—The statutory return of this company shows that out of a nominal capital of £20,000, in £1 shares (10,350 preference and 9,650 ordinary), seven preference shares only have been taken up. The amount upon these shares (£7) is still outstanding.

Crystal Palace District Electric Supply Company, Limited (18,532).—This company filed its yearly return on November 4th last. It is stated that out of a nominal capital of £100,000, in £1 shares, 28,586 shares have been taken up, and that the full amount has been called on each. A sum of £14,420 has been received, and £14,166 has been agreed to be considered as paid.

Brush Electrical Engineering Company, Limited (29,533).—This company's yearly return, filed on November 15th, 1894, shows that out of a nominal capital of £750,000, in 150,000 £3 ordinary and 150,000 £2 preference shares, 90,000 ordinary and 90,000 preference shares have been taken up, and that the full amounts have been called on each. The sum received is £450,000.

Monte Video Telephone Company, Limited (27,208).—This company filed its annual return on November 20th, 1894. It shows that out of a nominal capital of £220,000, in 29,000 preference and 15,000 ordinary shares of £5 each, 28,000 preference and 15,000 ordinary shares, 25,000 preference and 12,000 ordinary shares have been taken up. A sum of £185,000 has been received, and £30,000 has been agreed to be considered as paid.

National Company for the Distribution of Electricity by Secondary Generators, Limited (18,309).—The annual return of this company has lately been filed. It is stated that out of a nominal capital of £500,000, in 3,000 preference and 47,000 ordinary shares, all of £10 each, 2,669 preference and 20,000 ordinary shares have been taken up. The full amount has been called and paid on 1,669 preference shares, and £17,690 has been received, which includes a sum of £1,000 paid on 100 shares forfeited. A sum of £210,000 has been agreed to be considered as paid.

Collier-Marr Telephone and Electrical Manufacturing Company, Limited (36,989).—The registered office of this company is now at the works, Derby Street, Oxford Road, Manchester, Lancs.

Lamina Accumulator (Elieson's British Patent) Syndicate, Limited (39,144).—The registered office of this company, which was formerly at 8, Regent Street, W., is now at Broad Street Avenue, E.C.

Ernest Scott & Mountain, Limited (32,760.)—This company's last annual return shows that out of a nominal capital of £70,000 in £10 shares, 5,663 shares have been taken up. The full amount has been called on 972 shares, £6 5s. has been called on each of 1,991 shares, and £5 on each of 500 shares. The total received is £24,668 5s., taking in a sum of £4 10s. paid on shares forfeited. There have been 2,200 shares issued as fully paid.

Marchant, Young & Co., Limited (39,576).—This company's statutory return shows that out of a nominal capital of £4,000, in £1 shares, 1,785 shares have been taken up. A sum of £5 has been called, being the full amount on five shares, which is still outstanding. There has been £1,780 agreed to be considered as paid.

English and Colonial Electric Light Company Limited (41,336).—The statutory return of this company has lately been filed. It shows that out of a nominal capital of £50,000 in £1 shares, only seven shares have been taken up and paid.

Brompton Electric Fittings Company, Limited (28,755).—The secretary of this company writes the Registrar of Joint Stock Companies that the whole of the assets have been sold, and the creditors paid. Business has ceased for many months, and it has been requested that the name be struck off the Register. The letter bears the date of December 22nd, 1894.

Electricity Supply Company for Spain, Limited (29,103).—This company's last annual return shows that out of a nominal capital of £100,000, in 19,900 ordinary and 100 founders' shares, all of £5 each, the whole of the shares have been taken up, and that the full amount has been called and paid on each of the ordinary shares. A sum of £500 has been agreed to be considered as paid.

General Electric Company, Limited (29,433).—This company's annual return was filed on December 15th, 1894. The document shows that out of a nominal capital of £85,000, in 7,000 first preference, 1,000 second preference, 4,000 ordinary, and 5,000 third preference shares, all of £5 each, 6,525 first preference and 1,400 third preference shares have been taken up, and that the full amount has been called on each. A sum of £39,625 has been received, and £25,000 has been agreed to be considered as paid.

Gordon Electric Traction Syndicate, Limited (32,227).—This company's last return, filed December 19th, 1894, shows that out of a nominal capital of £2,400 in £10 shares, 240 shares have been taken up, and that the full amount has been called on each. A sum of £1,800 has been received, and £600 has been agreed to be considered as paid.

"Electricity" and "Electrical Engineering" Newspaper Company, Limited (32,775).—This company has been in the hands of a receiver since October 6th, 1893. This gentleman is Mr. Walter Hughes, of 74, Coleman Street, E.C. Mr. S. Rentell, of 29, Ludgate Hill, E.C., writes the Registrar of Joint Stock Companies on November 6th, 1894, that he purchased the undertaking on November 20th, 1893, and that since that date the paper has been carried on by him personally as his own property.

Foreign and Colonial Arc Accumulator Company, Limited (34,021).—This company's annual return was filed on December 7th, 1894, and shows that out of a nominal capital of £1,000, in £1 shares, 1,000 shares have been taken up, and that the full amount has been called on each. Nothing has been received, and £993 has been agreed to be considered as paid.

Acme and Immisch Electric Works, Limited (40,125).—This company's statutory return, filed August 15th, 1894, shows that out of a nominal capital of £25,000 in 20,000 ordinary and 5,000 preference shares, all of £1 each, 18,623 ordinary and 1,590 preference shares have been taken up, and that 2s. has been called on each of 1,590 preference shares. A sum of £158 has been received, £18,623 has been agreed to be considered as paid, and £1 is outstanding.

F. H. Royce & Co., Limited (41,362).—This company's statutory return shows that out of a nominal capital of £30,500, in 30,000 ordinary and 500 deferred shares, all of £1 each, 12,933 ordinary, and all the deferred shares, have been taken up. The full amount has been called on each.

Great Western Electric Light and Power Company, Limited (41,488).—This company's statutory return shows that out of a nominal capital of £1,000, in £10 shares, 7 shares have been taken up. Nothing has been called or paid.

BUSINESS NOTICES, &c.

Urgent.—All names, addresses and advertisements intended for insertion in the Universal Electrical Directory of 1895 should be at once forwarded to the publishers, 22, Paternoster Row, London, E.C.

Belfast.—Prof. Kennedy will visit Belfast early this year to superintend the testing of the machinery.

Edinburgh.—It was stated at a recent meeting of the Town Council that current would be turned on from the Corporation Works about next March.

Halifax.—The electric light is being taken up extensively, the consumers connected or about to be connected numbering 120, which represents about 3,000 lamps.

Islington.—The foundation stone of the Vestry's electrical works was laid last Thursday. The site is to cost £9,000, the buildings £18,000, and the plant £33,000.

Richmond.—The electric lighting of the Terrace House, Richmond, Surrey, where over 200 lights of 16 C.P. will be installed for Max Waechter, Esq., has been entrusted to Mr. C. A. Hemingway, of Petersham Road. The work will be carried out under the supervision of Mr. Morgan Williams, A.M.I.C.E., M.A., 39, Victoria Street, S.W. Among other private house installations now in progress, may be mentioned Norfolk Lodge for C. E. Rube, Esq., 106 lights, and Terrace Lodge, for the late John Edgar, Esq., 46 lights.

Rottingdean.—It is proposed to light the village of Rottingdean by electricity, the mains will also extend to Ovingdean.

Sunderland.—Part of the Public Library is to be lighted by electricity.

Wynyard Park.—At Wynyard Park on Thursday night last week, on the occasion of the ball which was given in honour of the debut of Lady Helen Stewart, the electric light was very much in evidence. The ordinary electric lighting system at the hall numbers no less than 1,200 lights and this was supplemented on

Thursday night by a temporary installation of about 400 extra incandescent lights, whilst four 2,000-candle-power arc lanterns were also put on for exterior illumination, chiefly the north front of the hall where guests alighted. All this was done without extra engine power being required, thus showing the advantage of the duplicate method working. The permanent and temporary installations were laid down by Messrs. Drake & Gorham. Mr. Drake, jun., of the firm, and Mr. Jenkins, the resident electrical engineer at Wynyard Park, superintended the lighting arrangements. Messrs. Drake & Gorham have a commission from Lord Londonderry to light his lordship's town house, Londonderry House, Park Lane, by an installation of about 1,000 lights.

An Accident at Dublin Electricity Works.—Electricity is not responsible for all the accidents at electric light stations. Some days ago a lad employed at the Dublin Works while carrying some paraffin oil fell, the liquid saturating his clothing and becoming ignited. But for the assistance of Mr. H. T. Harris, who tore off the clothing and wrapped his own great coat round the lad, a terrible death must have resulted.

Appointments.—Mr. A. G. Roe, of Bournemouth, and Mr. G. H. Swetenham, of Ealing, have been appointed electricians to the P. & O. steamers, *Kaiser I. Hind*, and *Shannon* respectively. They qualified under Mr. Ronald A. Scott, M.R.I., M.I.E.E., Acton Hill Electrical Engineering Works, Limited. These appointments make the seventh and eighth gained in the P. & O. service by members of the Acton Hill Works.

Calendars, Diaries, &c.—From the Electrical Power Storage Company, Limited, we have received as usual one of their very useful blotting pads, arranged for use during the year 1895. A marked improvement in this year's pad, compared with that sent out last year is the arrangement along the top of the pad of the days of the year, one slip being detached at the end of the month. At the beginning of the small diary arranged at the left hand side is a large quantity of useful data regarding prices of the E.P.S. batteries; there is also a quantity of other serviceable information necessary for office work.

We have received date calendars for the year 1895 from the Indo-European Telegraph Company, Limited; Mr. J. W. Vickers, advertising agent; and Messrs. Flowerdew & Co., law stationers, &c.; from the Commercial Cable Company's New York staff, we have received the season's greetings in the form of a nicely prepared card which illustrates, in a number of small views, the laying of the new Atlantic cable by the ss. *Faraday* during last year.

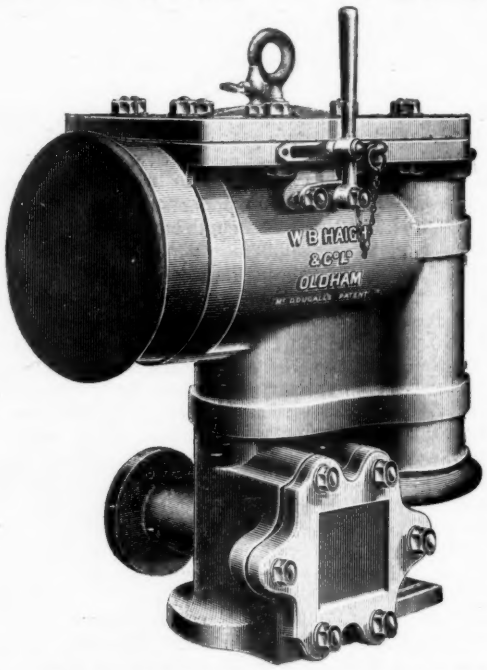
Change of Name.—Messrs. Williamson & Joseph have issued a circular letter which contains the following: "We beg to inform you that, from this day (January 1st, 1895), we shall trade under the name of 'Williamson & Joseph.' Mr. W. T. Burbey ceased to be a member of this firm on July 1st last, and contrary to anticipation, has started business again. We therefore do not wish to be in any way identified with him, and have made the alteration with that view. The business is identically the same as that established under the name of 'Appleton, Burbey, & Williamson' in the year 1887, and the undersigned are the sole partners.—We are, yours faithfully, Albert Edward Williamson, Edward Lionel Joseph."

Correction.—The notice headed Islington in our last issue should read St. Luke's, Middlesex. That Vestry has nothing whatever to do with Islington. The Islington Vestry are themselves the undertakers in their own district.

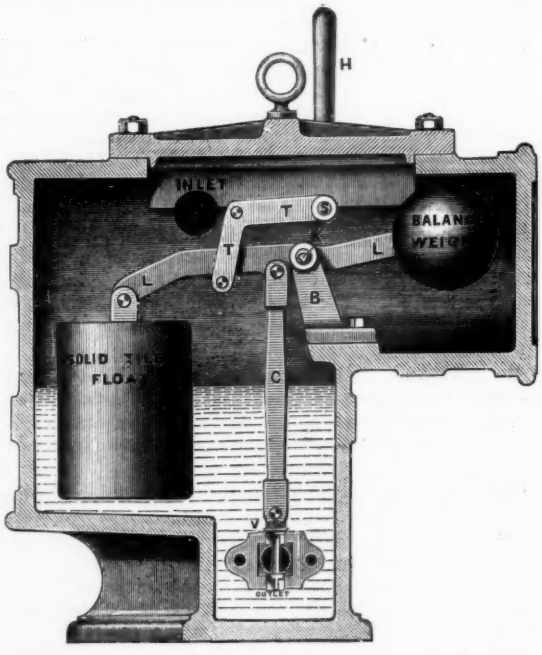
Electric and Steam Fire Alarm.—The New Hey and Milnrow Local Board have accepted the tender sent in by Mr. R. S. Blackburn, electrical engineer, of Hebden Bridge, for an installation of his patent combined electric and steam fire alarm buzzer. By means of this invention a steam buzzer is electrically set in action at a distance from one or any number of points. The Hebden Bridge Local Board adopted this system some eighteen months ago, and the results are perfectly satisfactory.

Lighting of the Bombay Municipal Offices.—The Bombay new municipal offices have been fully equipped with the electric light. The plant is of the Thomson-Houston type, the steam engine plant being by Marshall, Sons & Co., Limited.

McDougall's Steam Trap.—Generally speaking, all steam traps are dependent upon two main principles, viz.: (1.) one in which the valve is operated by the expansion and contraction of metals; and (2.) one in which the valve is opened by a float. One of the most serious drawbacks to the expansion steam trap is that it operates too slowly. Engineers who have had to deal practically with this subject recognise that provision must be made to guard against damage arising from a sudden inrush of water. To wait until the steam trap valve is closed by heat and opened by the cooling action of the atmosphere is altogether too slow a process; so much so that the damage sought to be avoided may have taken place long before the steam trap could have time to operate. Another drawback to the expansion principle is that the valve must be set to correspond with the highest temperature and pressure, and consequently is not suitable for variable pressures without adjustment. Steam traps constructed on the expansion principle may be made to work satisfactorily when the quantity of water to be discharged and the steam pressure are constant. Many varieties of steam trap have been made on the float principle, the greater part of which have been made with hollow copper floats enclosed in rectangular cast-iron boxes. Such steam traps are only suitable for low pressure work. We illustrate herewith a steam trap, which, although somewhat expensive, appears to embody the essential features of a good steam trap. The McDougall steam trap is the invention of Mr. McDougall and Mr. Thomas Sugden, and has, we understand, been largely adopted for electric lighting purposes. It can operate quickly, and



having a balanced valve does not require any adjustment, as it is not affected by any variation of steam pressure. We also note there is a free outlet for water; that is, the valve opening is equal to the area of the inlet. There is a well at the bottom of the trap which prevents the dirt coming in contact with the valve and seating. The testing arrangement for blowing through whilst at work is a good feature. There is practically only one joint, namely, the one which supports the lever, and this is arranged with a knife edge, and having



plenty of clearance avoids any liability to sticking. These steam traps are made to stand any pressure up to 300 lbs. on the square inch. The illustration is almost self-explanatory. The shell is cylindrical in form, and specially adapted to withstand high pressure. Within this cylinder moves a lever, L, on a suitable fulcrum, K. On one end of the lever is placed a solid tile float, which, being a little heavier than water, is counter-balanced by an iron balance weight on the other end of the lever. The position of this weight is adjusted so that the float may begin to rise at the desired point. Near the fulcrum a long link, C, connects the lever, L, with the equilibrium valve, V. As the solid tile float, encased in sheet copper, is lifted by the accumulating water in the vessel, the valves are opened, and the water discharged. Both the weight and float are solid, and free from contact. Practically, the only moving part is the

fulcrum, K, which works on a knife edge in a large opening, so that the friction is reduced to a minimum. A test lever, H, suitably connected to the lever, T, is provided for testing or to blow through the valves, when steam is first turned on, any grit that may have settled on the valve seatings. The test lever is arranged to both open and close the valve, and by this means any sticky substance which may become attached to the valve and seating is discharged. A stop pin ensures the test handle and lever being kept in the correct position when working. The pin is withdrawn when blowing through, and after this operation must be replaced. To expel the air a pet cock is provided which can be substituted by an automatic air valve when required. A door is provided at the bottom of the trap for easy access to the valve, so that same can be got at without breaking the top cover joint or in any way disconnecting the piping whatever. These steam traps were formerly made by the Chadderton Iron Works Company, Limited, and are now manufactured by Messrs. W. P. Haigh & Co., Limited, Globe Iron Works, Oldham.

Partnership.—Mr. Arthur H. M. Francis, who was formerly manager of the Dublin branch of Woodhouse & Rawson, and later with the Edison-Swan United Company, has gone into partnership with Mr. Spilsbury as general electrical agents. The address of the firm is 20, Bucklersbury, E.C.

Personal.—We understand that Mr. J. T. Gent, of Messrs. Gent & Co., of Leicester, has been returned by a large majority over his nearest opponent as a member of the new Board of Guardians for the town of Leicester under the ballot act.

Mr. E. Garcke's future address will be 1 and 2, Great Winchester Street, E.C.

Presentation.—Last Monday the staff and messengers of the Western Union Telegraph Company, Baldwin Street, Bristol, presented Mr. J. Hamilton with a handsome pair of vases upon his being transferred to the company's Penzance station.

Removal.—Messrs. Krupka & Jacoby have transferred their offices and showrooms from Bedford Place to 15, Queen Street, Cheapside, where they will keep a stock of carbons, &c.

Ronald A. Scott, Limited.—We understand that Mr. Percy T. Travers, chartered accountant, of Ryder Street, St. James's, S.W., has been appointed receiver for the debenture holders in this company. The company was registered on 15th June last.

State of Trade during the Year 1894.—We have received a number of reports from firms connected with the electrical industries of work executed during the past year, amongst which are the following:—

Bennett & Druce, Preston.—During the short time this firm has been in existence, now slightly over 12 months, they appear to have had a very large slice of the electrical work in the north of England. They make mill work their specialty, and a great deal of reliance seems to be placed in them for work of this nature. They have found business fairly good, but prices have been low, owing to the keen competition in the trade. During the 12 months they have fitted up about 4,700 lamps, with 20 arc lamps and 15 dynamos (one being a 78-kilowatt machine), three steam engines, three gas engines, and one battery. About two-thirds of this number of lights have been erected in mills.

Dorman & Smith.—This firm report a decided increase of output from all departments, and have accordingly had a very busy year. The export trade, more especially to India, China, Japan, Russia, Australia, and the Cape has grown enormously, while in the home trade the increase of the provincial is more marked than that of the London district. The greater demand for main switchboards for both central station and private plants has necessitated the addition of a new large three-storied wing to their new works in Salford, which are expected to be shortly ready for occupation. Distributing gear for the transmission of power now forms a quite important item, and it is noticed that this is confined mostly to pumping and traction, and that the colonies are progressing faster in this direction than the "old folks at home." The extension of the electric light in works and warehouses, evidenced by the large demand for cheap and strong fittings, shows that it no longer remains a luxury exclusively for the homes of the very wealthy. From a financial point of view, "it seems that the introduction of improved processes and machinery is more responsible for the gradual reduction in prices obtained than the unhealthy competition with tottering concerns which a few years ago rendered the management of a manufacturing business so difficult." From the orders in hand, and inquiries for future delivery, they feel confident of another good year.

Doulton & Co., Lambeth, London.—This firm, in addition to their usual large business in insulators for telegraph and telephone, battery jars, and the numerous applications of pottery to electrical purposes, have during the past year executed several important contracts for the supply of their patent stoneware conduit for underground electric light mains. Among these may be mentioned Edinburgh and Sunderland. The former scheme is being carried out on an extensive scale, upwards of 15 miles of conduit having been laid. The system has also been used at Chelmsford, Preston, Brighouse, Liverpool, Manchester, and by several of the London supply companies—in all upwards of 140,000 yards of "ways" having been laid. Although of comparatively recent introduction, the Doulton conduit may be regarded as one of the standard systems available to engineers. Messrs. Doulton, we are informed, have, during 1894, supplied most of the insulators required for underground bare copper mains throughout the kingdom, and they have special facilities for expeditiously turning out large quantities of these insulators. They have also supplied the insulators for one of the few important electric traction schemes in this country. Another distinct branch of this firm's business is the erection of plant for the purification and softening of water. Their process has been extensively adopted for steam boilers, and also for manufacturing purposes where the use of impure or hard water would be attended with disadvantage. They now have in hand plant of this description for the St. Pancras electricity works. Space prevents more than a passing reference to Messrs. Doulton's numerous other productions, such as plumbago crucibles, stoneware chemical apparatus, &c.

Johnson & Phillips.—All the departments of this firm have been uniformly busy during the year. The manufacture of alternators, dynamos, transformers, and central station accessories, has been more than double that of any previous year, and the firm have been busy on several large contracts. One of the most important was a polyphase electric transmission of power plant for South Africa, which is now being erected by the firm's representative at the mines. Another important contract was the installation for the lighting of the Waterloo Goods Station at Liverpool, for the London and North Western Railway. Here a complete plant was supplied for 36 arc lamps and over 700 incandescent lamps. This firm also obtained the contracts for the central station of the Bedford Corporation Electricity Works, and the steam alternators and arc lamps for Tunbridge Wells. The cable department has been very busy with the manufacture of high class vulcanised cables for installation and underground work, for which the number of orders still continues to increase, and a large new shop has been added to this part of the works to enable the work to be turned out more rapidly. Large quantities of cable have been sent abroad, principally to Spain and South Africa. An important contract executed by this department was the laying of the high tension feeders on the Brooks insulated oil system, for the Worcester Corporation. The activity exhibited in the arc lamp department during the past year testifies to the popularity of the Brockie-Pell arc lamp, for which a large number of orders have been received. Amongst others, these lamps have been supplied during the last 12 months to the General Post Offices in London, Glasgow, and Hull, to the London and North Western Railway, Liverpool, Great Northern Railway, King's Cross and Holloway, the Lancashire and Yorkshire Railway, the Corporations of Wolverhampton, Ealing, Londonderry, Portsmouth, Nottingham, Birmingham, and Tunbridge Wells. Mr. William Whiteley, of Westbourne Grove, is also very extensively using the Brockie-Pell lamps, and a large number have been supplied for lighting the Blackpool Tower and buildings, and for many other important installations. The orders for carbons have been very large during the past 12 months, and greatly in excess of previous years. The manufacture of the "D. P." accumulator has kept this particular department more than usually busy. Orders continue to come in steadily. The Perry meter, which has been taken up by the firm, has been greatly perfected, and this department is very busy in executing orders for the latest permanent magnet type, which, we hear, has everywhere proved most satisfactory in its working. Generally, the progress made during the past year is highly satisfactory, and the outlook for the future is very gratifying.

Meldrum Bros.—The use of forced draught has come much into favour during the past year amongst the managers of electric lighting central stations, as is evidenced by the fact that Messrs. Meldrum have fitted their now well-known furnaces at the electrical generating stations in Bolton, Pontypool, Glasgow, Loughborough, Bootle, Blackburn, Belfast and Dublin; while their adoption has been decided upon by the authorities at Newport, Stafford, and Islington. These furnaces have been for some time past in use at the House-to-House Company, of West Brompton, Electricity Supply Company for Spain, in Madrid, City of London Electric Light Company, and various other stations. At Rochdale refuse disposal works, the "Meldrum" is fitted to seven boilers, house refuse being the fuel employed; the refuse is efficiently destroyed and disinfected in an entirely novel form of combustion chamber, and the heat from the fires is utilised to raise steam in the boilers. Part of the steam thus raised is employed in the production of electric light with entirely satisfactory results, full particulars of which will probably be available in a short time. Already Messrs. Meldrum Bros. have orders in hand for further work of this kind. The convenience of this form of draught, as compared to unassisted chimney draught in central lighting stations, is found very great, even apart from the question of economy; the command of the steam supply is improved, as all the draught can at any moment be applied, and the boilers worked to their fullest capacity during a sudden call for steam, while the draught can be regulated with the same facility to suit a very slow fire. With respect to economy, the saving in bars alone is an important item, as the "Meldrum" bars are practically indestructible, whilst small fuel can be burnt efficiently, as well as anthracite, small coke, &c., with which it would be useless to attempt to maintain steam with a chimney draught alone.

The Brush Electrical Engineering Company.—This company's works, both in England and Vienna, have been fully occupied during the year, the contracts upon which they have been engaged including all classes of work in connection with electric lighting, both for isolated installations and central stations. They report a very large increase, not only in the number of men employed in their works, but also in their outdoor contract department, where they have had large gangs continually employed both in putting down central station works, and also in laying and extending the mains in various towns. Extensions in central station plant have been carried out at Huddersfield, Sheffield, Bournemouth, and Hastings, while central station contracts at Hanley, Worcester, Lancaster, Leicester and Coatbridge, have been completed during the year. Electrical plant has been supplied for Bolton, and the Great Northern Railway Company's station at Holloway. The electric lighting, also, of the Industrial Exhibition at Earl's Court last summer was carried out by plant of the company's build. The company is at present engaged upon the Dover, Wandsworth, and St. Luke's town lighting contracts, as well as upon the engines for the Cierkenwell station, and exten-

tions at Bournemouth, Leicester, Worcester, Hanley, and other places. The orders received during the year include some of the above-mentioned town lighting contracts, and in addition a complete installation at Malta, and the supply of plant for the London Exhibitions, Limited. Among the more important orders which have been completed in the way of isolated installations, may be mentioned the lighting of Arundel Castle for his Grace the Duke of Norfolk; Battenhall Mount, Worcester, the residence of the Hon. Percy Allsop; High Tree Mansion, Redhill, the property of M. Marcus, Esq., and The Grove, Harefield, belonging to George Webster, Esq. The company have now in hand a large arc lighting plant for the Leith Docks Commissioners, and the lighting of the Public Library and Town Hall, by means of dynamos and gas engines, for the West Ham Corporation. With regard to contracts abroad, the company's Vienna works have recently supplied direct current plant for the central lighting stations of Wolfsberg, Ried, Zara, Schönlinde, Kitzbühel, Sternberg, Ujhely, and Eisenstein, in Austro-Hungary; while, in France, Mordey-Victoria alternators have been installed in the towns of Montargis, Riez, and Voreppe. In Australia, the company's branches at Sydney, Melbourne, and Adelaide have carried out important works, including the supply of plant to the Broken Hill Proprietary Company, and the Rockhampton Coal and Gas Company, also the lighting of the Hotel Metropole, Sydney, of the Hobart Exhibition, and of the Sugar Mills in Queensland. Among other foreign orders may be mentioned the supply of generating plant for the lighting of the Dutch State Railways Station at Flushing; of alternating current power transmission plant for Switzerland; of projectors for the De Beers Mines Company, South Africa, and the extension of the town lighting station at San Carlos do Pinhal, Brazil. One of the interesting features of the company's record during the past year has been the entire lighting of the Hastings sea front by a large number of Brush alternate current arc lamps. The Brush-Vienna arc lamp has also been put in the market since last Christmas, and the headway it has made has been of the most gratifying description. While this lamp is suitable for either direct or alternating currents, it has proved itself a peculiar success with the latter, and the company have been overwhelmed with orders for its supply, both at home and abroad. The Brush-Vienna dynamos, which were just making for themselves a place in Great Britain 12 months ago, appear to have found much favour in the eyes of users of electricity, if an opinion may be formed from the numbers which the works have been called upon to build. Lamp-holders, plain fittings, volt and ammeters, are now among the manufactures of the company, and it is anticipated that the high class workmanship and moderate price that are characteristic of these goods will secure for them a large and increasing demand. The company have now taken the sale of their incandescence lamps into their own hands, and have just issued a new price list, giving a description of the various types which they manufacture.

The Electrical Company, Limited.—In spite of the generally reported depression of trade, this company reports having had a very successful year. The promising aspect of 1893, since November, in the incandescent lamp trade, has assumed unexpected proportions during the present year, and at present most of the largest buyers of incandescent lamps, including Her Majesty's Government, may be found on the company's books. The Electrical Company's lamps have, in many respects, gained a high reputation, and are at present, as the "E.C." lamps, known throughout the country, and they have even brighter prospects for the future. In the arc lamp department the sale has almost doubled during the year, and the "Luna" arc lamps, both for direct and alternating current, are enjoying great success. We recently described the "Luna" lamp. A new differential alternating current lamp, with constant focus, is just now being added to the already large variety of arc lamps of the company's make, and it is expected that this lamp, in connection with the company's choking coils, will materially assist to make alternating arc lamp lighting a success, particularly for indoor and shop lighting. For high tension series installations a new and separate automatic cut-in and cut-out arrangement has been added. The sale of lamp holders has steadily increased, until it has reached more than three times the amount of last year. The Dolivo measuring instruments have also procured a ready and increasing sale. Stabilit, an insulating material supplied by the company, is stated to be highly appreciated wherever it has been used. Some of the most prominent firms have testified to having been highly satisfied with all the qualities of this material. For high tension work this material is most suited for insulating purposes. During the course of this year a new department has been added, namely that of "Transmission of Power and Light," by means of the now well known three-phase system, of which the main factory of the firm, the General Electricity Company of Berlin, have made a speciality for the last four or five years, with most satisfactory results. By means of this system, which is an alternating current one, distance no more plays that important part as it does in transmission of power plants by means of direct current. It is a system by means of which power and light can be transmitted at the same time and from the same plant, motors being used which can start under full load, can easily be reversed, and have absolutely no commutators, whereby sparking is, of course, an impossibility. These motors are therefore (besides being used for all ordinary purposes) particularly adapted for running in coal mines, where the ordinary motor, with commutator and its inherent sparking, is not advisable, and even dangerous. Although this department has only been started a short time ago, a goodly number of very important orders and inquiries to the extent of 8,000 H.P. are already in hand. All power installations are carried out by and under the supervision of the Electrical Company, Limited, who are backed up by their head quarters, the General Electricity Company of Berlin, whose paid up capital is £1,000,000 sterling. The company attribute their large trade to the fact that they have kept an extensive stock in hand, thereby being able to give immediate delivery.

The Direct Spanish Telegraph Company, Limited.—This company inform us that they will, on 1st January, 1895, open offices at Liverpool and Manchester for the reception and delivery of telegrams exchanged with Spain by their direct cable system between England and Spain *via* Falmouth—Bilbao.

CONTRACT OPEN.

Bristol.—The Corporation of Bristol invite tenders for the installation of the electric light at the Guildhall and a portion of the Council House. Plans may be seen at the office of the City Electrical Engineer, Mr. H. Faraday Proctor, A.M.I.C.E., M.I.E.E., Temple Back, from whom specifications may be obtained. The lowest or any tender not necessarily accepted. Tenders to be sent to "The Chairman of the Finance Committee, the Council House, Bristol," by January 18th, 1895, endorsed "Tender for electric light installation."

CITY NOTES.

Elmore's Foreign and Colonial Patent Copper Company.

The fifth annual ordinary meeting of this company was held at Cannon Street Hotel on Monday last.

Mr. F. L. Rawson presided, and moved the adoption of the report and accounts. He pointed out that the general expense of carrying on the business of the company was almost one-third less than before. The board had decided to write off the value of the deferred shares in Elmore's American and Canadian Patent Copper Depositing Company, on the ground that there was no hope of such shares ever realising anything like their face value. This, however, did not represent any actual pecuniary loss, as the company would continue to hold the shares for whatever they might ultimately realise. After providing for this reduction in the company's assets, there remained a surplus of £166,417 5s. 5d. The past year had been a most trying one; but the board believed that their difficulties, which were chiefly of a financial character, had now been overcome. The French company had escaped liquidation, and the German company had attained to a perfectly satisfactory position from a manufacturing point of view. The result of the present working of the companies here and on the Continent confirmed the directors' belief that the statements made by the company would be more than borne out. Negotiations were on foot for the sale of the Belgian, Indian, Italian, Russian, and Spanish patents. In order to raise the necessary capital to carry on the company, it was proposed to issue £5,000 of first mortgage debentures.

Mr. J. J. Atkinson seconded the motion, which was agreed to.

The question of raising fresh capital was then discussed. It appeared from the chairman's statement that the directors had met the most pressing financial claims against the company during the year.

A small committee of shareholders was appointed to confer with the directors as to the best mode of issuing the debentures, and to settle the security to be given.

On the motion of the Chairman, Mr. Shurmer (the secretary) was elected as director, in the place of Mr. W. Elmore, who, as previously understood, now retires.

Messrs. Jackson, Pixley, Browning, Husey & Co., were re-elected auditors, and the meeting closed with a vote of thanks to the chairman.

British Electro-Chemical Agency, Limited.—Notice is given in the *London Gazette* that a petition for confirming a resolution reducing the capital of the above company from £75,000, divided into 7,500 shares of £10 each, to £50,000, divided into 2,500 vendors' shares of £10 each, and 5,000 ordinary shares of £5 each, such reduction to be effected by reducing the nominal amount of each of the said 5,000 ordinary shares from £10 to £5, was on November 1st, 1894, presented to Her Majesty's High Court of Justice, and is now pending, and that the list of creditors of the company is to be made out as for February 1st, 1895.

Stock Exchange Notices.—The Royal Electric Company, of Montreal, have asked for a special settling day and a quotation to £120,000 4½ per cent. 20-year first mortgage debentures.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending December 30th, 1894, amounted to £859; week ending December 31st, 1893, £837; increase, £22; total receipts for half-year, 1894, £23,306; corresponding period, 1893, £21,886; increase, £1,420.

The Cuba Submarine Telegraph Company. The estimated traffic receipts for the month of December were £3,400; as compared with £3,834 in the corresponding month of last year.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending December 30th, 1894, amounted to £837; corresponding week last year, £619.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 28th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,899.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation December 22nd.	Closing Quotation, January 2nd.	Business done during week ended January 2nd, 1895. Highest.	Lowest
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	102 —105	100 —103xd	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 12s.	£2 15s.	£2 11s.	38 — 39	38 — 39	...	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 5s.	£5 10s.	£5 2s.	71½— 72½	71½— 72½	72	71½
2,993,560£	Do. do. Defd.	Stock	...	...	...	6¼— 6⅝	6¼— 6⅝	...	...
130,000	Brazilian Submarine Teleg., Ltd.	10	8 % §	6½% §	6½% §	10⅝— 11¼	10½— 10⅝	10⅝	10½
75,000£	Do. do. 5 %, repayable June 1906	100	...	...	...	111 —115	109 —113xd	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	... §	10%‖ §	... §	2 — 3	2 — 3	2½	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	140 —150	140 —150xd	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	3½% §	2 % §	2 % §	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½— 13¼	12½— 13½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4½%	4 %	4 %	4¼— 4⅜	4¼— 4⅜	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	10 %	9¼— 9⅜	9¼— 9⅜	...	...
30,000£	Do. do. 4½ % Debs of £50, Nos. 1 to 1,600	...	...	...	...	105 —108%	105 —108%	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½% §	3½% §	2⅝% §	8¼— 8⅜	8¼— 8⅜	...	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	6½% §	15⅝— 16⅛	16 — 16¼	16⅛	16
70,000	Do. 6 % Pref.	10	6 % §	6 % §	6 % §	16¼— 17¼	16⅜— 17¼	...	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	...	...	...	106 —110	106 —110	...	...
1,297,837£	Do. 4 % Mort. Deb.	Stock	...	...	...	119 —122	120 —123	122	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	16 — 16¼	16⅛— 16⅜	16¼	16 3/16
54,100£	{ Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	...	...	...	103 —107	101 —105xd	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	104 —107	102 —105xd	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	118 —122	119 —123	...	...
95,100£	{ Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343 }	100	...	...	...	103 —107	101 —105xd	104¼	...
129,100£	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	104 —107	102 —105xd	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	105 —108	105 —108	106	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	109 —112%	109 —112%	109⅜	...
180,227	Globe Telegraph and Trust, Ltd.	10	5¼% §	4⅜% §	4⅜% §	8¼— 9	8¾— 9	9	8¾
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 % §	15⅝— 16¼	16 — 16¼	...	...
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜% §	8⅜% §	8⅜%	21⅜— 22¼	21½— 22xd	...	...
190,000£	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	105 —108	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	47 — 49	47 — 49	...	...
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000£	Do. do. 6 % Debs.	100	...	...	...	102 —106	102 —106	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	¼— ⅜	¼— ⅜	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1⅛— 2⅛	1⅛— 2⅛	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	6 % §	5 % §	5 % §	5⅛— 5⅜	5⅛— 5⅜	5⅜	5 3/16
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	15 — 16	15 — 16	15⅛	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5¾— 6	5¾— 6	5 1/16	5⅞
1,000,000£	Do. 4½ % Deb. Stock Prov. Certs. ...	...	...	...	...	110 —113	... ...	...	...
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	7/16 — 9/16	½— ⅝	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	105 —108	103 —106xd	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	0 %	2 — 4	2 — 4	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	110 —115	110 —115	...	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	1 — 2	1 — 2	...	...
146,733£	Do. do. 5 % Debs.	Stock	...	...	...	88 — 94	86 — 91xd	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	..	0 %	3 — 5	3 — 5	...	...
238,300£	Do. do. do. 5 % Debs.	100	...	...	...	101 —104	101 —104	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½— 2½	1½— 2½	1½	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	100 —105	96 —101xd	...	...
64,245	Western and Brazilian Teleg., Ltd.	15	4 %	2½%	2½%	11½— 11⅝	11½— 11⅝	11⅞	11
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	6½— 6⅝	6½— 6⅝	...	...
33,129	Do. do. do. 5 % Def.	7½	3 %	...	...	4⅞— 5¼	4⅞— 5¼	5¼	5
171,900£	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	101 —105	101 —105	...	...
214,800£	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	101 —105	101 —105	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	⅜%	1 — 1½	1 — 1½	...	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10⅜— 11½	10⅜— 11½	...	...
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	...	9 — 10	9 — 10	...	...
80,000£	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	109 —112	107 —110xd	...	...
$1,211,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	112 —118	112 —118	...	...
166,900£	Do. do. 6 % Ster. Bonds.	100	...	...	...	102 —104	102 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	...	5 %	4½%	4½— 5⅛	4½— 5½	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	14 — 15	14 — 15	...	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	...	6 %	6 %	14⅜— 15½	15 — 15½	15⅜	15½
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	132 —135	130 —133xd	131	...
50,000	†Liverpool Electric Supply, all paid	5	4½%	5 %	5 %	7⅜— 7½	7 5/16— 7 7/16	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	1 %	2 %	2½%	9½— 10½	10 — 10½	10⅝	10
100,000£	Do. 5% Deb., bonds of £10, £20, £40	...	...	...	...	... — ...	... — ...	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	...	...	...	116 —118	115 —118 xd	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	7¼— 7⅜	7¼— 7⅜	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	8½%	7¼%	4½%	7⅜— 8¼	7⅜— 8¼	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8¼— 9	8¼— 9	...	...
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	...	3½%	4 %	7 — 7½	7¼— 7⅜	...	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, Dec. 22nd.	Closing Quotation, Jan. 2nd.	Business done during week ended Jan. 2nd, 1895. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	...	6 % §	6 % §	2½— 2¾	2½— 2¾	2⅝	2 9/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	...	6 % §	6 % §	2⅝— 2⅝	2⅝— 2⅝	...	...
125,000*l*	Do. do. 4½ % Deb.	Stock	...	...	...	111 —114	111 —114	...	...
630,000*l*	City and South London Railway	Stock	...	⅝%	⅝%	42 — 44	43 — 45	44¼	43¾
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	7 % §	3 — 3½	3 — 3½	...	...
50,000*l*	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	97 —102	97 —102	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	¼— ½	¼— ½	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½— 2	1½— 2	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd., 1 to 66,750 ...	2	*nil*	*nil*	*nil*	1/16— 3/16	1/16— 3/16	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil* ¶	*nil*	*nil*	1 — 1¼	1¼— 1½	1 7/16	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	*nil*	¾— 1	1½— 1⅝	1½	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	*nil* §	½— 1½	½— 1½	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	...	...	6½— 7½	6½— 7	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	5 %	8½— 9½	8½— 9½	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	12½%	25½— 26½	25½— 26½	...	...
200,000*l*	Do. do. do. 4½ % Deb., 1896	100	...	...	...	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	...	1 %	8½— 8⅝	8⅝— 8¾	...	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	13 — 13¼	13 — 13¼	...	...
	Swan United Electric Light, Ltd.	...	11 % §	10 % §	7½% §	... — ...	... — ...	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	20 %	41 — 43	41 — 43	...	...
150,000*l*	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	106 —109	104 —107 xd	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2¼— 2½	2¼— 2½xd	2 7/16	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50 % for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%§; 1890—8%§.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—6.
Charing Cross and Strand Electricity Supply Corporation, £57,400—5 % Debentures.
Electric Construction Corporation, 6 % Debentures, 93—97.
Electric and General Investment, shares of £5 (£1 paid), 1¾—2¼.
House-to-House Company (£5 paid), 2¼—2½.
Do. do. 7 % Preference, of £5, 6⅛—6⅜.
Do. do. 6 % Debentures of £100, 101—103.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4¾—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6½—6⅝.
Liverpool Electric Supply, £5 (fully paid), 7 5/16—7 7/16.
London Electric Supply Corporation, £5 Ordinary, ⅛—1⅛.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4¼—4⅜.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

ECONOMY IN STEAM RAISING.

On December 17th, before the Cleveland Institute of Engineers, Mr. J. F. Meldrum read a paper on the above subject, which was practically confined to a description of the Meldrum system of forced draught. This system, now well known, and which has accomplished a good deal in realising an economy in steam raising, consists of a system of closed ashpit into which, by means of a special steam-worked air injector, large volumes of air can be forced to the furnace, and good combustion ensured in all states of the weather, a desideratum that is, perhaps, one of its chief advantages, for, as stated, a strong wind blowing from the boiler end will act to very seriously reduce the draught produced by the chimney, and when the atmosphere is laden with moisture the result is always unfavourable to draught. As each degree of temperature increases the bulk of a gas about $\frac{1}{491}$ of its volume at 32° F., a temperature of 600° will about double the normal bulk of air, and a chimney of 100 feet will, theoretically, produce a draught of about $\frac{3}{4}$-inch in water gauge. We observe that this temperature of 600°—the figure that Rankine gave as that necessary to give the best result, in quantity of air moved—is assumed by Mr. Meldrum without question as the normal temperature of a chimney, and he bases some of his calculations upon this figure. Now in this, we think, he is wrong. Lower temperatures of chimney than 600° give better efficiencies, economically considered, and we all know that lower temperatures are regularly secured in practice, so that it will not do to use the temperature of 600° as the datum on which to build estimates of economy, though, as claimed, there may be also frequent bad cases where even a higher chimney temperature is to be found.

Referring to the action of a chimney, the author states the case of a chimney over 300 feet high, which gave scarcely any draught through the fires, so numerous were the other openings to the chimney and flues in the shape of, no doubt, bad and porous brickwork. This is a point that has been more than once emphasised in our columns, and the painting or tarring of brickwork has been urged as a means of improving a draught, but it is difficult to get people to believe they can be losing anything through an apparently solid wall. Now, Mr. Meldrum claims this, and we think, with reason, to be one source of the benefit of his system of forced draught. When the flues are filled with gas at more than atmospheric pressure, there can be no leakage of cold air *inwards*, and with his steam-actuated draught, the advantages are:—1. Entire independence of wind or weather. 2. Availability of all combustion heat, none being needed to produce chimney draught. 3. No loss through bad brickwork, &c. 4. Regulation of air blast possible when the fire doors are open. 5. Reduced grate area, less air used per pound of fuel, and higher and more efficient furnace temperature. 6. Better boiler efficiency, and the power to use cheaper fuels, and it may be said that usually a cheap fuel is cheaper in price than its calorific power would seem to warrant. This, however, is less marked than it once was. Indeed, such furnaces as Meldrum's go to enhance the price of inferior fuels, difficult of combustion by ordinary means, and, apart from their other advantages, would destroy their own *raison d'être*.

Steam is used as the draught producer in the locomotive, by adding to the back pressure on the engines. This would not do in stationary work, but some 20 years ago Körting applied an air injecting device in the North-Eastern district by means of closed ashpits and a projecting iron box; but the boxes were in the way, and the blowers were noisy, and there was a lot of steam condensed, so that the box was always wet, and some of the boiler fronts corroded. Then the Perret furnace was introduced, with its fan-blown draught, deep bars and water ashpit, and naturally Mr. Meldrum could point out several disadvantages of the Perret furnace. We have ourselves, however, known some excellent results to be obtained with the Perret furnace. The Meldrum furnace is about seven years old, and some 2,000 have now been applied.

In it there are two steam blowers in each furnace, placed in the ashpit, and in no way projecting from the boiler front. The form of blower arrived at is believed to be final, and one that cannot be changed without loss of efficiency. Not any kind of a steam jet will serve the purpose, and the Meldrum blower is claimed to consume only some 2 per cent. of the entire evaporation, while even this is claimed to be made by the coal saved at the bars, which have air spaces only $\frac{1}{16}$th inch wide, and no fuel of any value falls through, and the bars are kept cool by the steam. Special provision by means of a valve in the dead plate is made to supply some air above the fuel to burn the gases found in bituminous coal, and the steam pipe for the blowers is taken round the furnace door to dry the steam before it passes to the blowers.

A table accompanying the paper gives a few results of evaporative costs. Thus, with coal at 10s., the cost per 1,000 gallons evaporated is 5s. 6d. and 5s. With coke dust at 4s., and coal at 5s., the cost is 2s. 9d. and 3s. 2d. per 1,000 gallons respectively, while coke dust at 1s. 8d. gives a result of 1s. 4d., and again, coke dust at 4d. gives a cost of 5d. per 1,000 gallons. The results appear to show that the dear fuels cost about double the cost of evaporating 1,000 gallons, while medium fuels have a ratio to cost of evaporation of 14 : 9, the poorer fuels costing about as much as the evaporation, or even less ; but the net result is in favour of the poor fuel, especially in grades not otherwise usable.

Naturally, the forced draught enables a boiler to be worked to its best results, and may even save the cost of putting in an extra boiler or a new chimney, as well as enabling the waste gases to be reduced to a lower final temperature, where means of absorbing the heat are at hand.

The Meldrum system was shown applied to a boiler of the Marine type for refuse burning, also to puddling and heating furnaces, with advantage, it is claimed, in working and in improved product, through greater ease in regulating the flame.

Though the author is probably prejudiced in favour of his own furnace, and apt to overrate some points, we think there is no doubt as to the system having proved its value.

During a recent visit to Lancashire we had the pleasure of seeing many boilers which were fitted with the Meldrum furnace ; not only were they exceedingly effectual with good fuels, but they were giving splendid results with the worst possible fuels. In one case, coke breeze, at 2s. 6d. a ton, was used, in another case, that of Messrs. Charlton & Sons, Blackfriars, Manchester, Cannel coke was utilised, and the fires in both instances were very good. But what was of intense interest to us was the use of the Meldrum furnaces at the Rochdale Corporation Sanitary Manure Works. The Corporation are anxious to combine, if possible, the manure works with electric lighting, and experiments are now being made as to the steam raising qualities of the refuse when using artificial draught. We hope, however, at a subsequent date, to refer very fully to this instance. At the moment, we would remark that it will not be surprising if something definite and satisfactory is accomplished with refuse at Rochdale.

SMALL DYNAMOS: THEIR CONSTRUCTION.

II.

THE core of an armature must have a cross-section of a certain minimum for each size of dynamo. For small machines from 1 to about 5 horse-power the section per horse-power varies from 6 square inches per horse-power for the larger size to 10 square inches for the 1 horse-power machine.

The section per horse-power is greater the smaller the dynamo, considering machines under 5 horse-power; for larger machines the section per horse-power varies with the speed.

Iron stampings in a core can be magnetised up to 18 or 20 lines per square inch of section, but iron wire cores are not worked above 16 lines per square inch. To be safe, we will adopt 15 lines per square inch for our armature core. The total flux, z, of magnetism through the armature will, therefore, be $15 \times 10 = 150$, $z = 150$.

Now, if z is multiplied by N, the speed per minute, which in our case we will fix at 1,800 and the product used as the devisor, to divide the volts desired to be produced, we will find the number of turns of wire required on the armature. Thus, $\frac{E}{z \times N} = N t$, but to get the E in practical volts, it must be multiplied by one million, that is, six cyphers added; in our case, 100 volts is = E, so that the figures would be $\frac{100,000,000}{150 \times 1,800} = 370$ turns of wire. Now we have got some important data for our machine.

Section of armature core	=	10 square inches.
z = total magnetic flow in core	=	150 lines.
N = speed of armature ...	...	1,800 per minute.
Nt = number of turns of wire	...	370 active.

But all the turns are not active on an armature, so that we must allow about 5 per cent. more turns, say, a total of 400 turns of wire.

The next question which arises is, what size to make the armature; we have, as yet, arrived at only one of its dimensions, its cross section.

To arrive at its length and diameter, we must, in small machines, consider the air spaces; that is, the spaces between the pole faces and the iron core, and in which room must be provided to accommodate the 400 turns of wire, the binding wires, and give a clear $\frac{1}{16}$th of an inch all round.

The area of the pole faces must be enlarged sufficiently to reduce the magnetic resistance of this space; the greater the area, the smaller the resistance of the air space.

First, let us consider the length of the air space. Our machine is to give 8 ampères; the smallest wire we can use on an armature for this current is No. 18 B.W.G. double cotton covered.

This wire, in four layers, will increase the diameter of the armature by half an inch, and to this must be added another quarter inch to allow for bands and clearances, so that our air space will be $\frac{3}{4}$-inch (or 0·75 inch), that is, $\frac{3}{8}$-inch on each side.

Now three lines per square inch of area of the pole faces is a good average induction in small machines, so that to get our total flux of 150, we must have $\frac{150}{3} = 50$ square inches of polar surface on each face of the armature embraced by the poles. A core 6 inches in diameter will meet this requirement, its circumference being 19 inches. We take $1\frac{3}{4}$ inches aside for the space between the horns, leaving us $15\frac{1}{2}$ inches, which, divided by 2, gives us $7\frac{3}{4}$ inches as the curved size of the face, and $\frac{50}{7{\cdot}75} = 6{\cdot}5$, or $6\frac{1}{2}$ inches as the length of our armature.

In addition to the figures already found, we have now to find the depth of the core only, and as we want 10 square inches $\frac{10}{6{\cdot}5} = 1{\cdot}54$ inch, or say, $1\frac{5}{8}$-inch; but as the flow divides, and one half flows through one side, and the other through the other side, $\frac{1{\cdot}54}{2}$ 0·77 will be the exact depth of the core, say $\frac{7}{8}$-inch a side. This gives the outside diameter of the core 6 inches, inside diameter $6 - 1\frac{3}{4} = 4\frac{1}{4}$ inches.

Now we can sum up the dimensions of armature core and winding.

ARMATURE.

Section	10 square inches.
Inside diameter	4¼ inches.
Outside diameter	6 inches.
Length	6½ inches.
Size of wire...	No. 18 B.W.G.
Number of turns	400
Weight of wire required	4½ lbs.
Outside diameter of wound armature ...	6⅝ inches.

We have now to find the electrical and magnetic dimensions of the field magnet. Our magnet will be of the Manchester type, two cores, and each core carries half the magnetic flow. The flow through the armature is 150; but, to provide against leakage and possible defects in material, we will add 25 per cent. to this, giving 190 lines, nearly, so that each core must carry $\frac{190}{2} = 95$ lines. This, at 16 lines

per square inch, would give $\frac{95}{16} = 6$ square inches as the cross section of each core; the cores being circular in section, a diameter of $2\frac{3}{4}$ inches full will be sufficient.

To find their length, we must first find the size and number of turns of wire to be used on them. This we do by finding the power required to drive the 150 lines through the air space and the armature, and the 190 lines through the cores of the magnets. The resistance of the air space is equal to its length, multiplied by 1,880, and by the induction per square inch area, in our case = 3; thus we have $0{\cdot}75 \times 1{,}880 \times 3 = 4{,}230$ ampère turns for air space excitement.

The resistance of the armature to the magnetic flow is found by taking its section and length also. The length of the path of flow will average 8 inches; in our case at 15 per square inch as the flow each inch in the path would take 55·7 ampère-turns, equal to $55{\cdot}7 \times 8 = 445{\cdot}6$ ampère-turns.

Thus we find that for the armature core and air space 4,230 + 445·6 ampère-turns are required = 4,675·6, half this on each core = 2,337·8. Allowing 1 ampère for exciting, we will require 2,337·8 turns on each bobbin, and each bobbin of 50 ohms resistance. No. 23 B.W.G. wire, is about 8 ohms per lb., so that about $6\frac{1}{4}$ lbs. will give 50 ohms; but as this wire will rise in temperature, we must allow for the consequent rise in resistance by using a little less weight—say, $5\frac{3}{4}$ lbs. on each bobbin.

A bobbin wound to a depth of 1 inch will hold this wire if $5\frac{1}{2}$ inches long, and the number of turns of wire will be 3,000 nearly, thus allowing about 670 ampère-turns for magnetising each field core.

The field cores will, therefore, be made 6 inches long, to provide a $\frac{1}{4}$-inch at each end of the bobbin for flanges and insulation.

The pole pieces will be $1\frac{3}{4}$ thick round the eyes into which the cores pass, and will taper out from a breadth of 4 inches to $6\frac{1}{2}$ inches, and from $1\frac{3}{4}$ inch to $\frac{3}{8}$ths inch.

The bore of the magnets tunnel is to be $6\frac{3}{4}$ inches full.

Now we can table the dimensions of the field magnet:—

FIELD MAGNET.

Diameter bore	$6\frac{3}{4}$ inches.
Length bore	$6\frac{1}{2}$ inches.
Length of cores	6 inches.
Diameter of cores	$2\frac{3}{4}$ inches.
Section of pole pieces at neck	$4 \times 1\frac{3}{4}$ inches.
Eyeholes in top pole piece	$2\frac{3}{8}$ inches.
Wire for field bobbins	$11\frac{1}{2}$ lbs.
Size of wire	No. 23 B.W.G.
Number of turns	3,000.
Exciting current	1 ampère.

In the next and concluding article, sketches of the parts, with mechanical details, will be given, particularly with regard to making up and fixing the parts.

The resistance of the armature will be about 1 ohm, so that at full load the electrical efficiency will be nearly $8^2 \times 1 + 100 \times 1 = 164$ watts lost in armature and field coils, 8 volts being lost in the armature; the total energy generated would be $108 \times 8 = 864$ watts, of which $864 - 164 = 700$ are available externally, *i.e.*, nearly 80 per cent. efficiency.

APPLICATIONS FOR PROVISIONAL ORDERS.

THE following applications for provisional orders were deposited with the Board of Trade on or before December 21st, 1894, under the provisions of the Electric Lighting Acts, 1882 to 1890:—

Title of order and description of area.	Name of promoters.	Agents.
Alderley Edge Electric Lighting Order. The Urban District of Alderley Edge.	The Urban District Council.	Messrs. Sharpe & Co., 9, Bridge Street, Westminster, S.W.
Bath Electric Lighting Order. The City of Bath.	City of Bath Electric Lighting and Engineering Co., Limited.	Messrs. Hargreaves and Co., 18, Abingdon Street, Westminster, S.W.
Bootle Corporation Electric Lighting Order. The Borough of Bootle.	The Corporation.	Messrs. Sharpe & Co., 9, Bridge Street, Westminster, S.W.
Brechin Electric Lighting Order. The Royal Burgh of Brechin.	Scottish House-to-House Electricity Co., Limited.	Messrs. A. and W. Beveridge, 10, Abingdon Street, Westminster, S.W.
Carlisle Corporation Electric Lighting Order. The City and Municipal Borough of Carlisle.	The Corporation.	Messrs. Mellor, Smith and May, 1, Moorgate Place, E.C.
Leigh Urban Sanitary Authority Electric Lighting Order. The Urban Sanitary District of Leigh.	The Local Board.	J. C. Ball, Esq., 16, Parliament Street, S.W.
Liverpool Electric Lighting Order. Portions of the City of Liverpool and of the Local Government District of Toxteth Park.	Liverpool Electric Supply Company, Limited.	Messrs. Ayrton, Radcliffe & Co., 9, Cook Street, Liverpool.
Llandudno Electric Lighting Order. The Urban Sanitary District of Llandudno.	The Urban District Council.	Messrs. Baker, Lees and Postlethwaite, 22, Great George Street, S.W.
Luton Corporation Electric Lighting Order. The Borough of Luton.	The Corporation.	Messrs. Sharpe & Co., 9, Bridge Street, Westminster, S.W.
THE COUNTY OF LONDON:		
Battersea Electric Lighting Order. The Parish of St. Mary, Battersea.	County of London and Brush Provincial Electric Lighting Company, Limited.	S. Morse, Esq., 4, Fenchurch Avenue, E.C.
Newington Electric Lighting Order. The Parish of St. Mary, Newington.	Do.	Do.
Notting Hill Electric Lighting Order. A portion of the Parish of St. Mary Abbotts, Kensington.	Notting Hill Electric Lighting Co., Limited.	Messrs. Romer and Haslam, 4, Copthall Chambers, E.C.
St. Olave's Electric Lighting Order. The District of the St. Olave's District Board of Works.	County of London and Brush Provincial Electric Lighting Company, Limited.	S. Morse, Esq., 4, Fenchurch Avenue, E.C.
Strand District Electric Lighting Order. The District of the Strand District Board of Works.	Charing Cross and Strand Electricity Supply Corporation, Limited.	Messrs. Wyatt & Co., 28, Parliament Street, S.W.
Margate Electric Lighting Order. The Municipal Borough of Margate.	Municipal Electric Light and Power Corporation, Limited.	Messrs. Wm. Webb and Co., 37 and 39, Essex Street, Strand, W.C.
Montrose Electric Lighting Order. The Royal Burgh of Montrose.	Scottish House-to-House Electricity Co., Limited.	Messrs. A. and W. Beveridge, 10, Abingdon Street, Westminster, S.W.
Motherwell Electric Lighting Order. The Burgh of Motherwell.	The Commissioners of the Burgh.	Do.
New Windsor Corporation Electric Lighting Order. The Borough of New Windsor and the Eton Urban District.	The Corporation of New Windsor.	Messrs. Sharpe & Co., 9, Bridge Street, Westminster, S.W.
Pontypool Electric Lighting Order. The District of the Pontypool Local Government Board.	Pontypool Electric Light and Power Co., Limited.	Messrs. Sherwood and Co., 7, Great George Street, S.W.
Prescot, Huyton and Roby, Rainhill, Eccleston and Whiston Electric Lighting Order. The District of the Prescot Local Board. The District of the Huyton and Roby Local Board. The Townships of Rainhill, Whiston and Eccleston.	British Insulated Wire Company, Limited.	S. Morse Esq., 4, Fenchurch Avenue, E.C.
Radcliffe Electric Lighting Order. The Urban Sanitary District of Radcliffe.	The Urban District Council.	Messrs. Baker, Lees and Postlethwaite, 22, Great George Street, S.W.
Salisbury Electric Lighting Order. The City of Salisbury.	Salisbury Electric Light and Supply Co., Limited.	Messrs. Sherwood and Co., 7, Great George Street, S.W.
Southampton Electric Lighting Order. The County Borough of Southampton.	Southampton Electric Light and Power Company, Limited.	Messrs. Deacon, Gibson & Medcalf, 9, Great St. Helens, E.C.

Title of order and description of area.	Name of promoters.	Agents.
Stirling Electric Lighting Order. The Parliamentary Burgh of Stirling.	The Commissioners of the Burgh.	Messrs Loch & Co., 11, Great George Street, Westminster, S.W.
Swindon New Town Electric Lighting Order. The Urban Sanitary District of Swindon New Town.	The Local Board.	Messrs. Martin and Leslie, 27, Abingdon Street, Westminster, S.W.
Walthamstow Electric Lighting Order. The Local Government District of Walthamstow.	The Local Board.	Messrs. W. Houghton & Son, 56, New Broad Street, E.C.
Winchester Electric Lighting Order. The City of Winchester.	The Corporation.	Messrs. Dyson & Co., 24, Parliament Street, S.W.
Windermere and District Electric Lighting Order. The Districts of the Urban Sanitary Authorities for Grasmere, Ambleside, Bowness, Windermere, and Kendal. The District of the Kendal Union Rural Sanitary Authority. The Districts of the Urban Sanitary Authorities for Ulverston and Grange. The District of the Ulverston Union Rural Sanitary Authority. A portion of the District of the Lancaster Union Rural Sanitary Authority.	Windermere and District Electricity Supply Co., Limited.	S. Morse, Esq., 4, Fenchurch Avenue, E.C.
Worthing Electric Lighting Order. The Borough and District of Worthing.	The Corporation.	W. Verrall, Esq., Town Clerk, Worthing.

PROCEEDINGS OF SOCIETIES.

Physical Society.

ORDINARY MEETING, DECEMBER 14th, 1894.

Prof. W. E. AYRTON and Mr. H. C. HAYCRAFT communicated a paper on a STUDENTS' SIMPLE APPARATUS FOR DETERMINING THE MECHANICAL EQUIVALENT OF HEAT.

Mr. HAYCRAFT, who read the paper, explained that the object at which the authors had aimed was the construction of an apparatus which could be placed in the hands of junior students, and by means of which a result correct within one per cent. could be obtained without the introduction of troublesome corrections. The method employed is the electrical one, and the measurements to be made are (*a.*) the value of the constant current passed through the resistance as given by a direct-reading ammeter; (*b.*) the average value of the P.D. between the terminals of the resistance, as given by a direct-reading voltmeter; (*c.*) the mass of water heated *plus* the water-equivalent of the containing vessel, resistance-coil, and stirrer; (*d.*) the rise of temperature of the water; (*e.*) the time during which the current is passed. Of these the measurements (*a.*) (*b.*) (*c.*) can be effected without the introduction of an error anything like so great as one per cent. The case of (*d.*) and (*e.*) is different. The rise of temperature, to be measured with accuracy, should be fairly considerable; and the same remark applies to the time of heating as measured by an ordinary stop-watch. At the same time, if these two quantities are made unduly great, there will be too great a ratio of heat lost to heat generated during the experiment. The authors consider that, with a given amount of electrical power available, the best conditions will be obtained by making the percentage accuracy of the temperature measurement, the percentage accuracy of the time measurement, and the percentage of generated heat lost by surface cooling, equal. Hence they determine the mass of water to be used, and the time of heating which may be expected to give the best results. The immersed conductor is a strip of manganin about 0·25 inch wide, 0·03 inch thick, and 5 feet long, which is bent into a series of zig-zags, so as to form a kind of circular gridiron, the successive portions of strip lying all in one plane, and the whole being held rigid by a strip of vulcanised fibre, to which each portion of the strip is screwed. Another precisely similar grid is placed three inches below the first, and the two are joined in series, and are mechanically connected together by thin vulcanite pillars. The water is contained in a glass beaker of just sufficient diameter to take the framework of manganin strip. This latter exposes a considerable surface (about 400 square cm.) to the water, and is moved bodily up and down during the experiment, thus constituting an efficient stirrer. To allow sufficient freedom of movement, electrical connection is made by means of very flexible leads, each made up of about 210 thin copper wires. The results obtained by students for the heat-equivalent of the watt-second have an average deviation from the mean, if several experiments are made, of less than one-half per cent.; and they agree with the best standard determinations within one per cent.

Mr. GRIFFITHS thought it inadvisable to provide junior students with apparatus from which every source of error had been eliminated; they were thus led to underrate the difficulty of an experiment, and the care required to obtain reasonable accuracy.

Prof. CAREY FOSTER agreed generally with Mr. Griffiths, and deprecated the use of direct-reading ammeters and voltmeters in experiments of this kind. He thought it preferable that a student should learn to reduce instrumental readings to absolute measure for himself.

Prof. S. P. THOMPSON dissented from the opinions expressed by the two previous speakers, and thought it was an advantage to students to have the use of direct-reading instruments.

Dr. SUMPNER described a simple method which he had employed for measuring the mechanical equivalent of heat, and which depended on the heating of a stream of water, as it flowed through a pipe containing the current-conductor.

Prof. AYRTON replied and explained that the calibration of ammeters and voltmeters would be part of the work of a student at another part of his course.

A paper by Prof. AYRTON and Mr. E. A. MEDLEY, entitled TESTS OF GLOW LAMPS AND DESCRIPTION OF THE MEASURING INSTRUMENTS EMPLOYED, was commenced by Mr. Medley, the latter part of the paper being held over till next meeting.

The object of the investigation was to find at what E.M.F. glow lamps could be most economically run. Too low an E.M.F. gives a low efficiency, and too high an E.M.F. renders the lamps short-lived; so that there must be (for a given lamp) a certain E.M.F. which is more economical to work at than any other. It was also pointed out that, as glow lamps deteriorate and become less efficient with use, it may be an economy to discard a lamp before the filament actually breaks. The lamp is then said to have reached the "smashing point." Accumulators were used to drive the lamps, automatic apparatus being used to keep the E.M.F. constant, and when a lamp-filament broke, the fact was automatically recorded on a tell-tale.

NEW PATENTS—1894.

24,486. "An improved apparatus for generating and applying heat, vapour, hot air, gas, medicine, and electricity to bodies or conveying it into bed, bath, or enclosure." E. D. T. SHEFFIELD. Dated December 17th. (*Complete.*)

24,499. "Electric apparatus for conveying and passing currents of electricity, induced, continuous, or currents of high frequency through footboards and oar handles and the bodies of rowers in lifeboats or other boats." E. S. D'ODIARDI and E. S. D'ODIARDI. Dated December 17th.

24,500. "Electrodes for conveying different currents of electricity through ladders, trapeziums, wheels, running tracks, dumb-bells, and any other gymnastic apparatus, and through the bodies of those who use them." E. S. D'ODIARDI and E. S. D'ODIARDI. Dated December 17th.

24,516. "Improvements in or relating to indicators or telegraphs for hotels, ships, offices, private houses, and for other purposes." R. BOWES. Dated December 17th.

24,534. "Velocipedes provided with electrical communicating apparatus." R. H. WOLFF. Dated December 17th. (*Complete.*)

24,541. "Method of and apparatus for effecting electrolysis." C. KELLNER. Dated December 17th.

24,551. "Improvements in electricity meters." P. COLLINSON. Dated December 18th.

24,564. "Improvements in and connected with electro locomotives." W. E. HEYS. (Communicated by J. J. Heilmann, France.) Dated December 18th. (*Complete.*)

24,583. "Improvements in electric heaters for cars." G. H. WHITTINGHAM. Dated December 18th. (*Complete.*)

24,588. "An improved form of pedal action for operating phonograph machines or the like." L. S. ROBINSON. Dated December 18th.

24,613. "An improved electric signalling system." W. P. HALL. Dated December 18th. (*Complete.*)

24,615. "Improvements in lightning arresters." S. P. BLACKMORE, and W. H. CARLIN. Dated December 18th. (*Complete.*)

24,625. "Improvements in electric safety appliances for railroads." E. L. OECUTT. Dated December 18th. (*Complete.*)

24,630. "Process of and apparatus for dissociating soluble salts by electrolysis." H. S. BLACKMORE. Dated December 18th. (*Complete.*)

24,638. "An improvement in or connected with binding screws for electric conductors." R. PELARGUS. Dated December 18th.

24,639. "Improvements in method and apparatus for purifying liquids magnetically, to which it may be added electrolysis and aeration." J. T. HARRIS. Dated December 18th. (*Complete.*)

24,673. "Improvements in treating gutta-percha." R. HUTCHISON and J. BINNIE. Dated December 19th.

24,679. "Improvements in apparatus for effecting the starting and stopping and the regulation, control, and governing of turbines, the supply of water to which is controlled by means of appliances

operated by means of hydraulic pressure." E. J. GUNTHER. Dated December 19th.

24,701. "Improvements in electrically driven hoists or lifts." TANGYES, LIMITED, and A. B. MEES. Dated December 19th.

24,707. "Improved process and material for the manufacture of buttons, articles of jewellery, stands for beer, glasses, piano keys, insulators for electrical apparatus, and other articles." R. PAPE. Dated December 19th.

24,714. "Improvements in secondary voltaic batteries." L. EPSTEIN. Dated December 19th.

24,732. "Improvements in and connected with the reproduction of objects by the aid of the electric current." F. I. RICARDE-SEAVER and L. PERNOT. Dated December 19th.

24,738. "Electrical ventilator for ducts, pipes, street boxes, transformer chambers, and other confined spaces used for or in connection with electrical mains and other electrical apparatus." E. M. LACEY. Dated December 19th.

24,745. "Detachable ornamental fibrous plaster covers for electric light ceiling fittings." F. J. CURLEY. Dated December 20th.

24,747. "Improvements relating to electric spring connectors." L. H. CLINE. Dated December 20th.

24,770. "Improvements in and relating to man-holes and man-hole covers for underground conduits and culverts, transformer chambers, &c." G. H. COTTAM. Dated December 20th.

24,796. "Improved electric igniting apparatus." A. FINDENIGG and J. SCHWARTZ. Dated December 20th.

24,859. "Improvements in the utilisation of waste or spent acid pickle from galvanising works or other works where iron is treated by acid, and in the treatment (for the recovery or obtainment of chlorine) of other products containing chlorine." T. PARKER. Dated December 21st.

24,860. "Improvements in the manufacture of potassium chlorate." T. PARKER. Dated December 21st.

24,861. "Improvements in the treatment of ores known as sulphide ores, for the separation and obtainment of the metals contained therein." T. PARKER. Dated December 21st.

24,864. "Improvements in the construction of primary electric batteries in order to make them portable when charged, with improved methods for carrying same, being especially adapted for use on the person, cycles, carriages, and the like kind." F. A. G. CASSELL. Dated December 21st.

24,873. "Improvements in telephones." W. P. THOMPSON. (Communicated by the Actien-Gesellschaft für Fernsprechpatente, Germany.) Dated December 21st.

24,876. "An improved apparatus for electrically winding up a driving spring." H. ARON. Dated December 21st.

24,899. "An improved dynamometer." L. SCHULER. Dated December 21st. (*Complete.*)

24,906. "Improvements in alternating electric current transformers." A. B. BLACKBURN and W. BUCHANAN. Dated December 21st.

24,907. "Improvements in electric arc lamps." A. B. BLACKBURN and G. W. FAIRALL. Dated December 21st.

24,908. "Improvements in apparatus for indicating and recording electric currents." A. B. BLACKBURN. Dated December 21st.

24,924. "Improvements in telephone switchboard plugs." J. TAYLOR. Dated December 21st.

24,926. "Improvements in dynamo-electric machines." A. B. BLACKBURN and W. BUCHANAN. Dated December 21st.

24,934. "An improved quick-break or make time switch." H. J. WAGG. Dated December 22nd.

24,951. "Improvements in safety fuses or cut-outs for electric circuits." H. B. BOURNE and W. F. BOURNE. Dated December 22nd.

25,014. "Improvements in electrical batteries specially applicable for use in connection with portable electric lamps." W. HERBERT and J. HERBERT. Dated December 22nd.

25,019. "A new or improved automatic switch for electromotors." F. M. NEWTON and T. HAWKINS. Dated December 22nd.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1893.

24,730. "Means for use in combination with conduits or conductors for the supply of gas or other fluid, or of electricity, for indicating the time during which such gas or other fluid, or electricity, has been consumed." F. G. S. CURTIS. Dated December 22nd. The inventor combines with the conduit or conductor a time keeper, which is provided with a device which can be brought into position to stop the time keeper, or into a position to release it. 4 claims.

24,790. "Improvements in brush holders for dynamo-electric machines." R. E. B CROMPTON. Dated December 23rd. Has for its object the cheapening of the construction of such brush holders and also their simplification, so that the pressure of the brushes on the commutator or collector may be easily adjusted while the machine is at work, and also so that they may be easily thrown on or off the commutator or collector. 3 claims.

1894.

3,111. "Improvements in electric signalling devices for telephone or similar circuits." R. HADDAN. (A communication from abroad by A. S. Williams, of New York.) Dated February 13th. Consists in novel features of construction of the switch arrangements of the telephone. 5 claims.

5,663. "Improvements in automatic cut-offs for gas, electric, and other conduits." J. KLEINE and F. LINDNER. Dated March 19th. Relates to a device for automatically checking a gas, electric, or other conduit, after the latter has been open for a certain definite time. 2 claims.

5816. "Improvements in electrical measuring measurements." H. H. LAKE. (Communicated from abroad by E. Weston, of America.) Dated March 20th. The invention embodies two coils —one of low resistance and placed in main circuit, and the other movable in the field of the first coil and placed in a circuit of relatively high resistance. The movement of the movable coil is counter-balanced by a coiled spring which also serves to lead the current to said coil. By reason of this construction the movable coil turns on its pivots when traversed by the current, and finds its own equilibration, so that in this way the watts are directly measured and indicated on the scale of the instrument. 5 claims.

6,606. "Systems for controlling electric lights." C. A. ALLISON. (Communicated from abroad by the Electrical Specialty Company, Incorporated, of America.) Dated April 3rd. Has for its special object, the controlling of lamps from any number of points in an incandescent circuit. 3 claims.

5,971. "Improvements in apparatus for the use of the electric light for photographic purposes." A. G. ADAMSON. Dated March 22nd. Is a further development of Patent No. 21,379, A.D. 1893. 2 claims.

6,669. "Improvements in porcelain and other insulators." J. C. FULLER and G. FULLER, and W. E. LANGDON. Dated April 3rd Claims:—1. The arrangement and construction of three or more deeply cut vertical grooves, or channels, the one extending below the other, whereby the surface distance between the conductor and the bolt is increased, all substantially as and for the purposes described and illustrated with reference to the drawings. 2. The combination with an insulator having deeply cut grooves or channels, and as claimed by Claim 1, of the serrated surface in the form of concentric rings, all constructed and arranged substantially as and for the purposes described.

6,742. "An electrically operated electric switch." SIEMENS BROS AND CO., LTD., and G. S. GRIMSTON. Dated April 4th. Relates to an electric switch, which is worked so as to open and close a circuit by currents of electricity transmitted from a distance. 3 claims.

7,215. "Improvements in electric printing telegraphic apparatus." E. MAGNIN. Dated April 11th. The complete apparatus which forms the subject of the present invention includes a manipulator or transmitter, a receiver, commutators provided with pegs, and the ordinary batteries employed in telegraphing. 3 claims.

7,307. "A new or improved electrical appliance for sounding an alarm when any desired temperature is reached, also serving as a fire alarm." C. BALBIANI. Dated April 12th. The inventor provides two spring blades mounted upon suitable standards, and connected by means of two strips of copper, brass, or other good conducting material, to a pair of ordinary electrical terminals, by means of which the device may be connected to the bell or battery wires. To each of the aforesaid spring blades is attached a small block of brass, copper, &c., so that upon coming together a good contact may be formed, these blocks being placed about midway in the length of the spring blades, whilst the lower ends of the said blades are furnished with a small point or projection for the purpose of gripping and securely holding a short length of wax or other suitable material whereby the said blades are kept apart, the whole device being mounted upon a base of wood or other material, and furnished with a perforated plate at the top, by means of which it may be conveniently suspended in any desired position or place. 2 claims.

7,617. "Improvements in thermo-electric generators." H. B. COX. Dated April 17th. A pile is formed of the sections of couples separated by suitable insulating material. The sections are suitably held together, and the outer and inner faces thereof are coated with cement or fire clay, or other suitable plastic refractory material, and baked hard. The pile is then like a hard stone structure or cylinder. 12 claims.

8,043. "An improved insulating cleat for supporting conducting wires for electrical circuits." H. B. WYMAN and A. C. GOODWIN. Dated April 24th. Consists of a cleat composed of porcelain, glass, or other material that is a non-conductor of electricity, adapted to be secured to any part of a building without danger of fire from the electric current passing through the wires connected to, or carried by, said cleat. 3 claims.

8,149. "Improvements in electrical measuring instruments." H. H. LAKE. (Communicated from abroad by J. van Vleck, of New York, and E. Weston, of New Jersey.) Dated April 24th. Consists in constructing the instruments with scales and pointers upon their peripheries or edges. 3 claims.

8,552. "Improved commutator brush." R. KERSBERG. Dated April 30th. Claim:—A commutator brush composed of intertwisted or separate spirals with or without an outer metallic weaving or the like, substantially as shown and described.

8,587. "Improvements in and relating to electric railways." H. H. LAKE. (Communicated from abroad by W. B. Purvis and M. M. Armstrong, both of Philadelphia.) Dated May 1st. Consists of means for automatically lifting portions of an electric conductor in order that the same may come in contact with sections of a conduit containing said conductor, and charge the same, so that the current may be transmitted to a motor on a car or vehicle. 7 claims.